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THE COST OF NOISE REDUCTION FOR DEPARTURE AND ARRIVAL OPERATIONS OF COMMERCIAL TILT ROTOR AIRCRAFT

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Flight Transportation Laboratory

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Table of Contents

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1.0 Introduction

The tilt rotor VTOL aircraft configuration is a contender for future intercity public transportation, particularly in densely populated regions. Like other rotary wing aircraft types, the tilt rotor is inherently quiet due to its low disc loading and low flow velocities in and around the propulsion device. However, intercity service would likely involve large vehicles and high frequency of operations at some terminals. Because of the small area of vertiports, aircraft operations would be closer to the surrounding non-user population. Thus the vehicles should be as quiet as possible.

In order to help assess the potential of tilt rotor aircraft as a viable part of an intercity transportation system, the relationship between noise reduction and operational cost increases must be known. There are two methods of reducing the noise exposure due to aircraft operations: changes in flight profile and changes in design. The aircraft trajectory can be moved further from the listeners, the amount of noise generated can be reduced by reducing thrust, or the speed can be increased in order to reduce noise exposure time. This method of noise reduction is explored for VTOL aircraft in References 1 and 2. This method does not generally have a significant impact on direct operating cost (DOC). The second method is to change the design of the aircraft to reduce the noise generated at a given distance, thrust level, and speed. This is the method considered here.

Design changes for noise reduction in a 12,000 lb. gross weight tilt rotor aircraft are discussed in Reference 3 in considerable depth both from the military point of view (to reduce aural detectability) and the commercial point of view (to reduce noise annoyance). It was found that reduction of the rotor tip speed used in the helicopter mode and during conversion is the most

effective means of reducing noise annoyance. Other design changes which were considered include variations in number of blades, blade tip shape, blade planform, blade airfoil section, blade twist, and blade spacing. Dramatic noise reductions could not be accomplished with these changes and they would not result in a dramatic change in DOC. Therefore these types of changes were neglected.

The object of this study was to develop the relationship between direct operating cost and noise annoyance for tilt rotor aircraft. This was accomplished by generating a series of tilt rotor aircraft designs to meet various noise goals at minimum DOC. These vehicles ranged across the spectrum of possible noise levels from completely unconstrained to the quietest vehicle that could be designed within the study ground rules. Optimization parameters were varied to find the minimum DOC. This basic variation was then extended to different aircraft sizes and technology time frames. This study is similar to one conducted previously by the Flight Transportation Laboratory for helicopters (Ref. 4). However, unlike the helicopter work, this study uses a single measure for evaluating total community annoyance due to a flight cycle composed of one departure and one arrival.

2.0 Design Procedure

In this study a large number of tilt rotor aircraft designs were created with the aid of a preliminary design computer program (Ref. 5). The purpose of this preliminary design program is to rapidly obtain parametric variations of the design for a set of particular requirements. The program does not internally optimize the design; this is done by the user. The program takes as input a set of design parameters sufficient to fix the design. It then performs the normal preliminary design calculations to obtain both the other design parameters of interest and various figures of merit. Figures of merit include performance parameters such as speed, payload-range, direct operating cost, and noise annoyance. The noise annoyance portion is the subject of section 3.

2.1 Program Description

A flow chart of the preliminary design computer program is shown in Figure 1. The program begins by reading input data. Various parameters which are independent of gross weight are then calculated: atmospheric properties, fuselage profile drag and constant weights.

Then the program goes into a design procedure which is an iteration on gross weight. Initially a gross weight is estimated from the constant weights; on succeeding iterations a new gross weight is found from those of the preceding two iterations.

Next rotors and wing are sized. The rotor radius is found from the input disc loading. The wing span is based on rotor-fuselage clearance. The wing loading is input and the area and aspect ratio are calculated. The hover thrust coefficient is found, using the input tip speed and corrected for wing download.

Fig. 1 Computer program flow chart

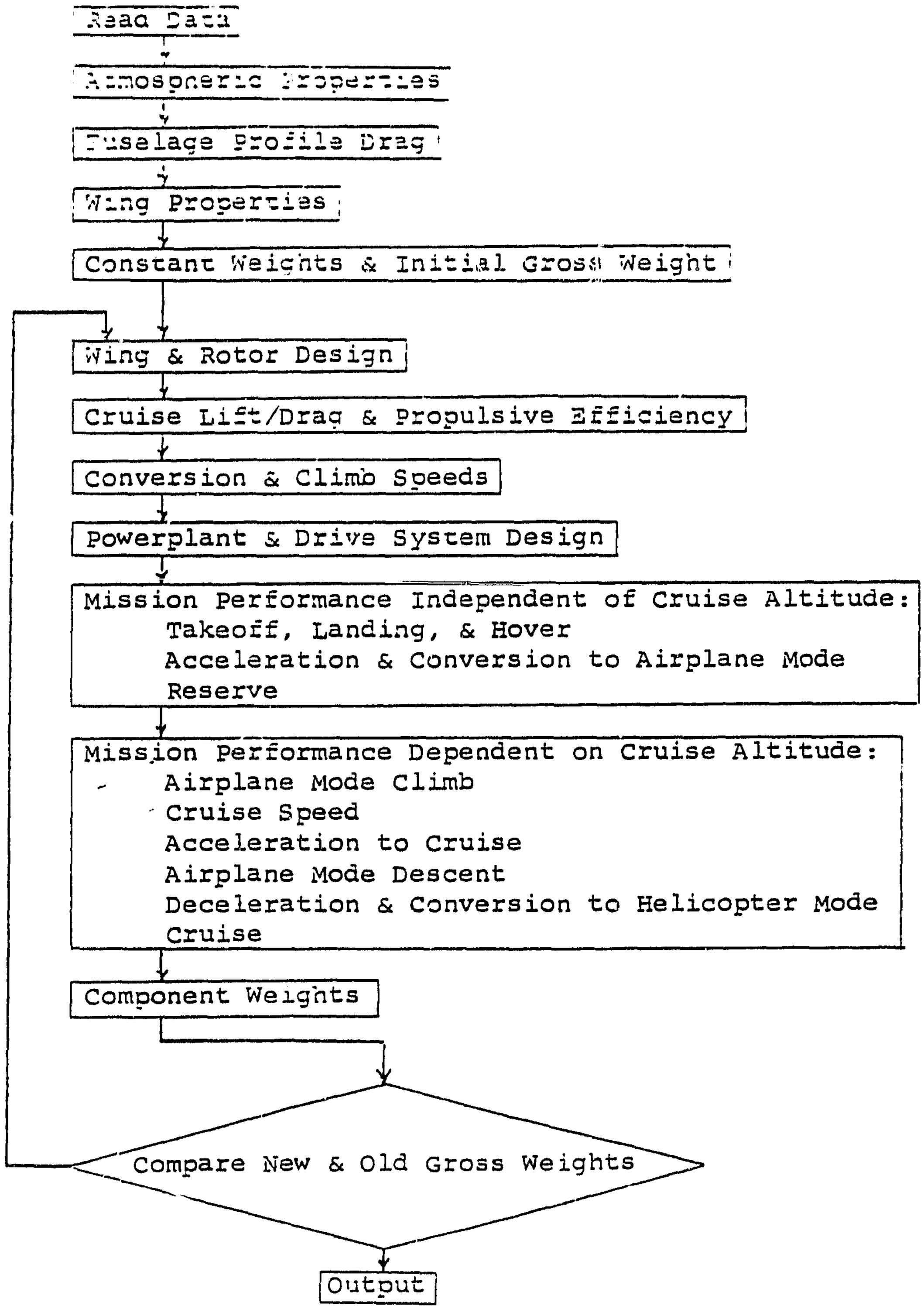
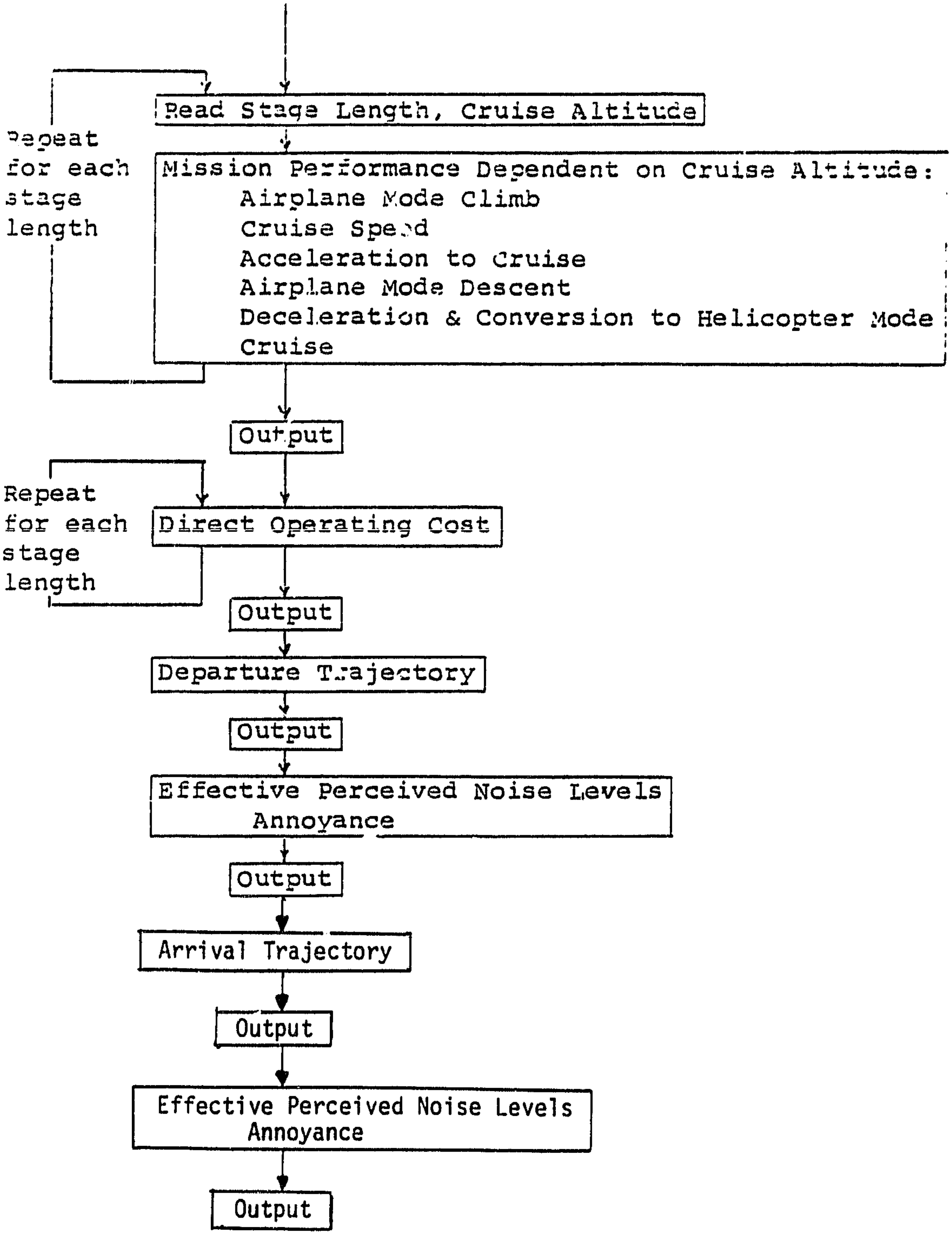


Fig. 1 Computer program flow chart (cont'd)



Then the rotor solidity is found using the input thrust coefficient to solidity ratio (C_T/σ).

The cruise lift to drag ratio is found from the wing and fuselage geometry. Then the cruise propulsive efficiency of the rotors is calculated according to an empirical formula from the cruise forward Mach number, the cruise tip Mach number, and the rotor solidity.

Next the airplane mode best rate of climb speed is calculated. Then the conversion speed and airplane mode wing lift coefficient are calculated, corresponding to the input helicopter mode maximum advance ratio. This lift coefficient and the ratio of the airplane mode best rate of climb speed to the conversion speed are output to evaluate conversion performance.

Then the powerplant is sized to the maximum of the requirements for emergency hover, conversion and cruise. The emergency hover requirement is for one engine out hover on a hot day at an input altitude. The conversion requirement is established by an input conversion power factor (labelled "Excess Factor Hel Mode" in the output) which is the ratio of conversion power desired to normal hover power. Power is corrected for temperature, altitude, forward speed and r.p.m. It is assumed that the engines operate at rated r.p.m. in hover and a penalty is accepted for any reduction in r.p.m. in the airplane mode. This completes the selection of design parameters.

The aircraft is then flown through the design mission to find the fuel consumed. The assumed mission profile consists of ten phases: takeoff, acceleration and conversion to the airplane mode, airplane mode climb, acceleration to cruise speed, cruise, airplane mode descent, deceleration and conversion to helicopter mode, hover, landing, and reserve. The portion which is independent of cruise altitude is done separately, so that it will not be repeated in the stage length variation later. The fuel burn rate is corrected

in each phase for power setting, r.p.m., forward speed and altitude. Optional provision is made for the aircraft to obey the FAA speed limit of 250 kt. IAS below 10,000 feet. If the aircraft has more installed power than that required for cruise at design cruise speed, and if the drive system and rotor limits permit, then the aircraft is allowed to cruise faster, up to these limits. Cruise fuel is calculated according the Breguet method.

Then the component weights are calculated. Both the rotor and drive system weights are taken to be the highest resulting from helicopter mode and airplane mode hover coning angle exceeds 8.5°, weight is added to approximate tip weight and blade weight necessary to reduce coning to this amount. Here it is assumed that the rotor is of the gimballed type having a first flatwise bending mode frequency of 2 per rev. The wing weight is independent of flap area, but is adjusted for the lift coefficient required in conversion.

Now the component weights and fuel weights are summed, which results in a new gross wieght. If the difference between the new and old gross weights is greater than ten pounds, the design procedure goes throught another cycle. When the iteration is complete, the parameters describing the final design are printed.

The vehicle is then flown through various input stage lengths which are less than the design range, with appropriate input cruise altitudes. The time, distance and fuel for each stage is calculated and printed. Then the program calculates the direct operating cost (DOC) for each stage length, by category, and prints this out. The DOC is calculated according the Lockheed/New York Airways formula. (Ref. 6)

2.2 Calibration

In order to calibrate the computer program, the program was used to produce approximations of two existing tilt rotor designs. These were the Bell D302

(Ref. 7) of 44,100 lb. gross weight and the Vertol 215 (Ref 8) of 67,000 lb. gross weight. These designs were picked because they represent the experience of two different firms and they are near the middle of the size range of interest. Both were configured as transport aircraft. However, they were designed to meet military requirements which compromised their effectiveness as commercial aircraft. By making allowances for the military requirements in the inputs to the computer program, good agreement with the original designs was obtained. Both of these designs are intended to represent approximately 1975 technology, and therefore the values of the technology factors which gave the best agreement in the calibration were considered to be 1975 values.

3.0 Noise Evaluation Procedure

3.1 Departure Path

After the direct operating cost portion of the computer program, the departure trajectory to 10,000 feet altitude is calculated in detail. The result is a time history of the distance, altitude, flight path angle, thrust and rotor tilt angle relative to the flight path. This history then is input to the noise annoyance calculation.

The departure path is shown schematically in Figure 2. (This path is intended to be an approximation of the minimum trip time path with the obstacle clearance constraint.) Throughout this path, acceleration is constrained by power available. There are three other constraints for passenger comfort. The acceleration builds up smoothly over a specified time to its allowable input maximum, which is used for all phases of flight. The rate of rotation of the acceleration vector after obstacle clearance is specified. Finally, the maximum fuselage pitch angle is specified.

To determine the departure path prior to the airplane mode climb, the program considers steps in velocity, of input size, and calculates the acceleration magnitude according to the routine shown in Figure 3. The rotor tilt angle is first found from the balance of forces perpendicular to the acceleration vector and the power limited acceleration magnitude is found from the force balance parallel to the acceleration vector. If the power limited acceleration is larger than the allowable acceleration, the force balances are set up again and solved for the thrust and a new tilt angle. The time, distance, altitude, and flight path angle are found from the acceleration and velocity. The forces and angular relationships are shown in Figure 4. The nomenclature is given in Table 1.

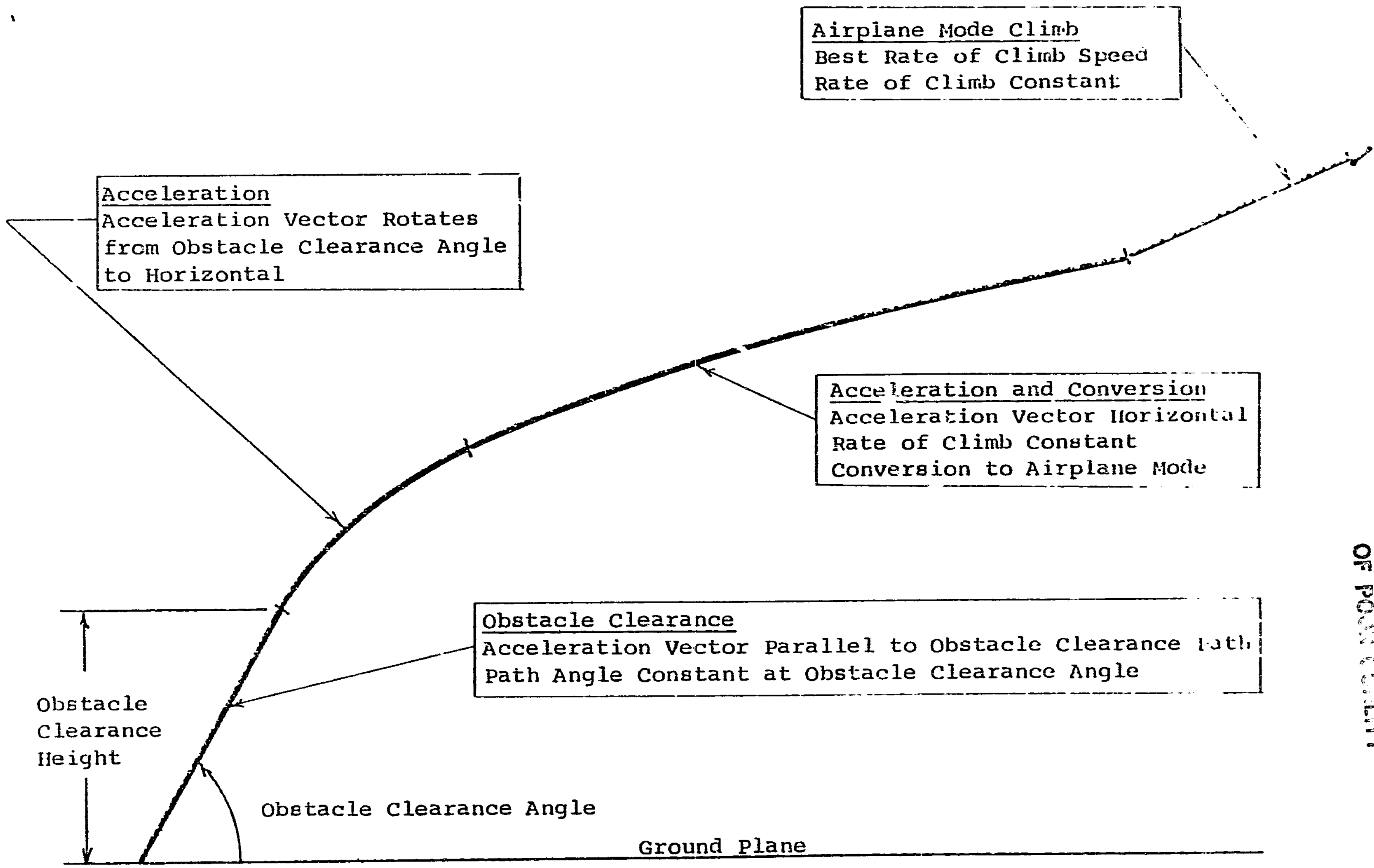


Fig. 2 Departure path schematic

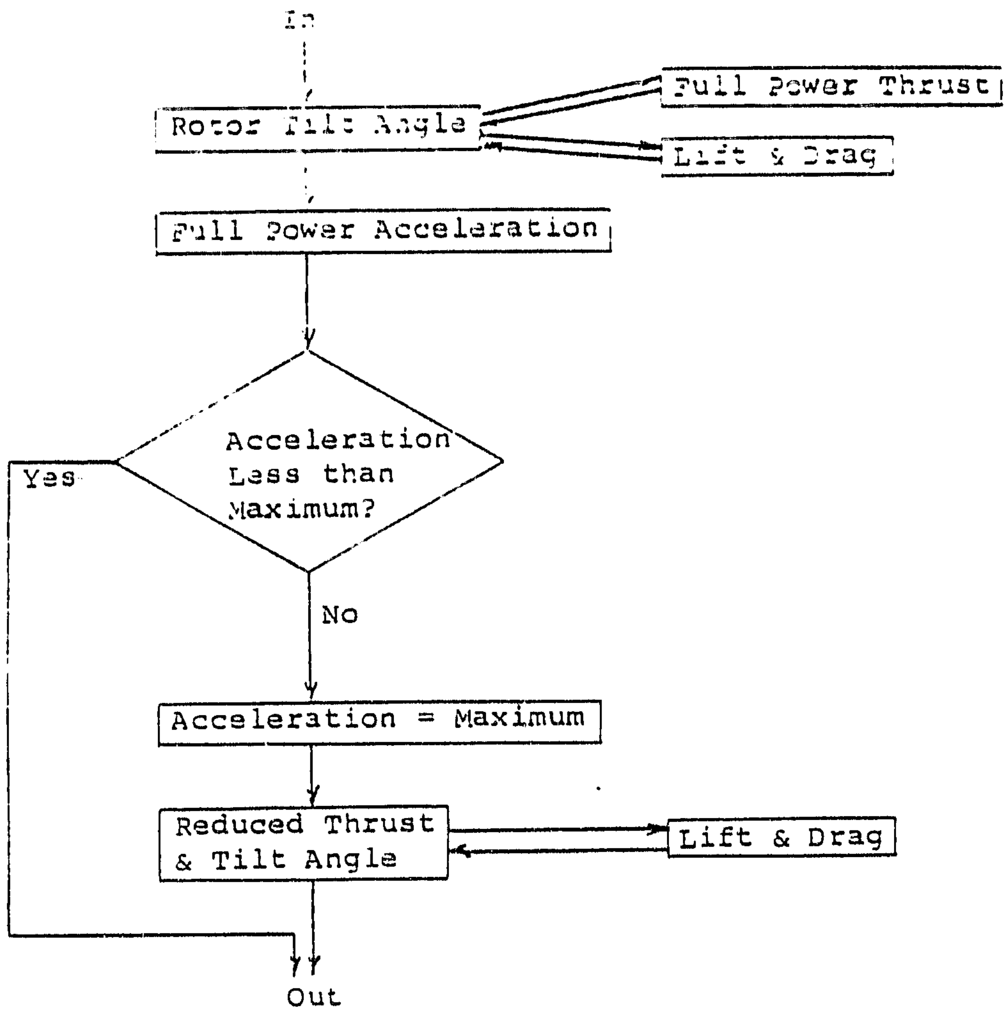


Fig. 3 Flow Chart for acceleration routine

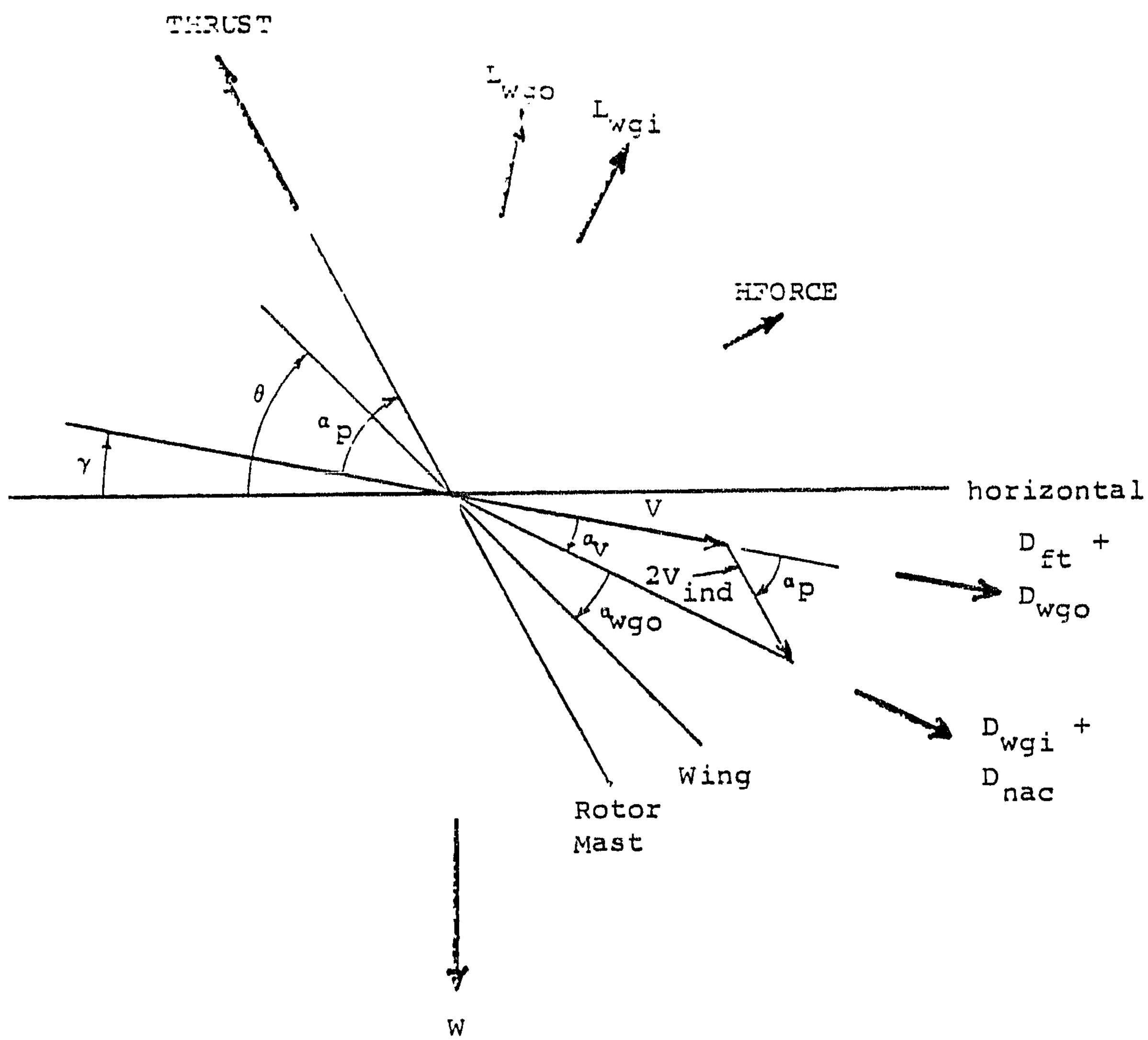


Fig. 4 Forces and angular relationships

Table 1 Conversion Nomenclature

Symbol	Computer Output Label	Description
V	VEL	Freestream Velocity, ft/sec
V_{ind}	not shown	Induced Velocity of Rotors, ft/sec
THRUST	THRUST	Total Rotor Thrust, lb.
HFORCE	Not shown	Total Rotor In-Plane Force, lb.
L_{wgo}	LWGO	Lift of Wing Portion not Influenced by Rotor Flow, lb.
L_{wgi}	LWGI	Lift of Wing Portion Influenced by Rotor Flow, lb.
L_{wg}	LWG	Lift of Wing, lb.
D_{wgo}	DWGO	Drag of Wing Portion not Influenced by Rotor Flow, lb.
D_{wgi}	DWGI	Drag of Wing Portion Influenced by Rotor Flow, lb.
D_{wg}	DWG	Drag of Wing, lb.
D_{nac}	DNAC	Drag of Nacelles, lb.
D_{lg}	DLG	Drag of Landing Gear, lb.
D_{ft}	DFUST	Drag of Fuselage and Tail, lb.
γ	GAM	Flight Path Angle, deg.
α_p	ALP	Angle between Rotor Mast and Freestream Velocity, deg.
θ	THE	Angle between Wing Zero Lift Line and Horizontal, deg.
α_{wgo}	AWO	Angle of Attack of Wing Portion not Influenced by Rotor Flow, deg.
α_v	ALV	Wing Angle of Attack Change Induced by Rotors, deg.

A simple model is used to predict the performance of the rotor and wing through the complete range of rotor tilt angles. Elementary helicopter blade element and momentum theory formulae are used to find the rotor thrust, since the advance and inflow ratios are not large. To predict the wing forces, it is assumed that the flow through the rotor is fully developed when it reaches the wing. Hence the portion of the wing that is influenced by the rotor is that portion which is overlapped by the inner half of the disc area. On this portion of the wing the total slipstream velocity is assumed to be the vector sum of the freestream velocity and the fully developed induced velocity of the rotor. The optimum flap deflection cannot be conveniently found, so it is assumed to be equal to the flight path angle. The aircraft is assumed to be pitched up to the input maximum, or until the angle of attack of the rotor-influenced portion of the wing is 3° less than stall, whichever is less, until the aircraft reaches the speed where the wing lift is equal to the gross weight.

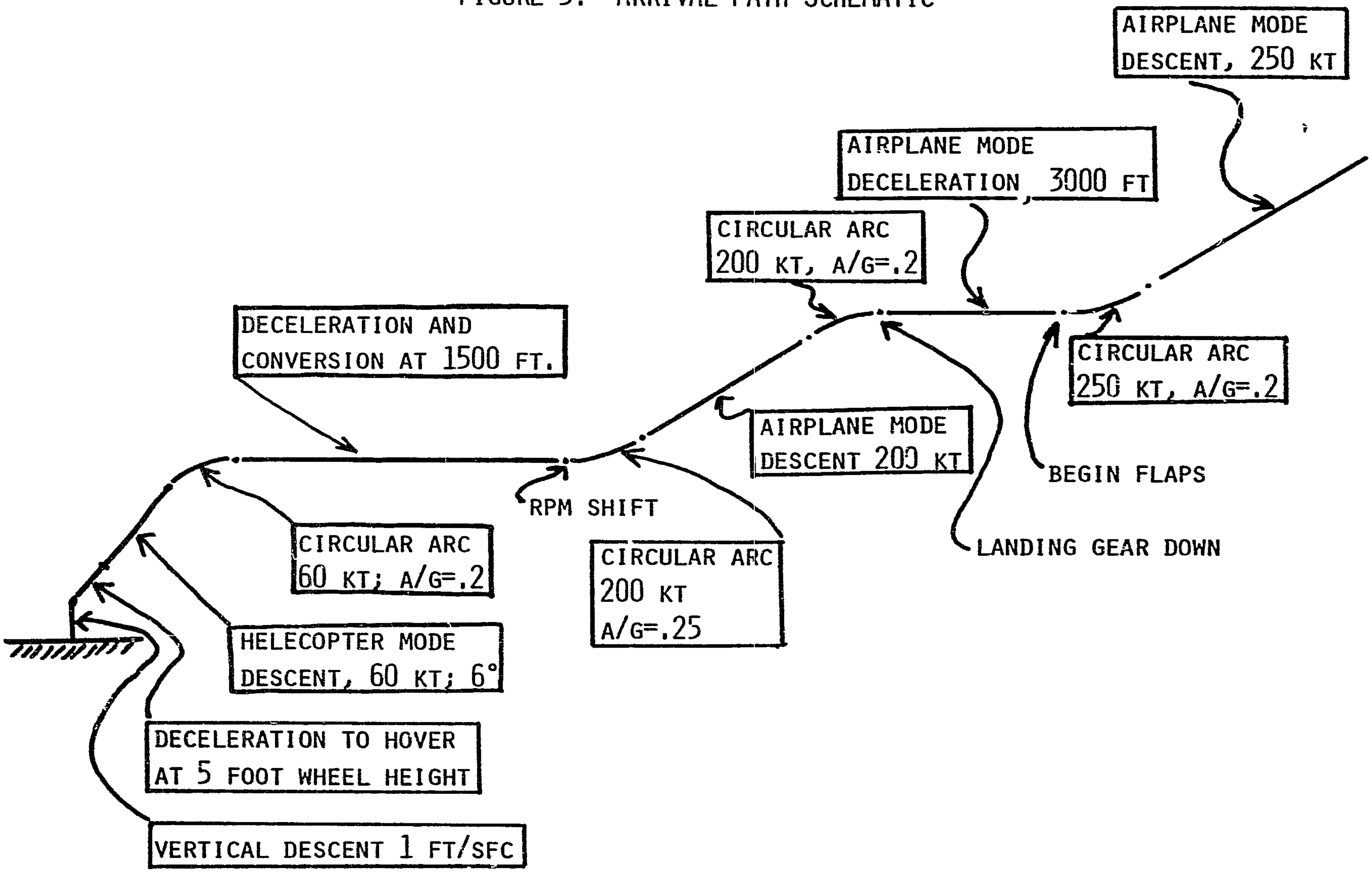
Conventional fixed wing methods are used to calculate performance at the beginning of the airplane mode climb and at 10,000 feet altitude.

3.2 Arrival Trajectory

The arrival trajectory is calculated in a manner analogous to the departure trajectory. Again the result is a table of time, distance, altitude, flight path angle, and rotor tilt angle relative to the flight path. The noise annoyance calculation is then repeated using this data. Finally, the annoyance for one departure operation and the annoyance for one arrival operation are added to give total annoyance.

The arrival path is shown schematically in Figure 5. This path is intended to be representative of realistic tilt rotor approach paths under instrument flight rules, assuming no fail-safe guidance or stability augmentation devices

FIGURE 5: ARRIVAL PATH SCHEMATIC



are available. This path is not simply a reversal of the departure path for several reasons. Some deceleration is required in the airplane mode prior to conversion because the airplane mode descent speed is higher than the airplane mode climb speed.

Deceleration to 200 knots must occur at or above 3,000 feet in order to comply with FAA speed restrictions within five miles of airports having control towers. It is desirable to continue in the airplane mode as long as possible to minimize trip time. Also, the maximum deceleration during the deceleration and conversion phase is too slow if the aircraft is permitted to descend at the same time. Hence, the deceleration and conversion is at 1,500 feet. The final helicopter mode approach phase must be at constant speed and at a shallow angle to prevent the rotors entering the vortex ring state, to avoid excessive pilot workload, and to allow a reasonable missed approach procedure.

In the straight line deceleration phases, the deceleration is always along the flight path and may not exceed the input maximum. The deceleration is smoothed as is done for the departure trajectory.

The trajectory for the airplane mode phases is calculated using conventional fixed wing methods. The airplane mode deceleration phase is divided into an input number of steps in velocity. The deceleration at each velocity is found using a routine shown in Figure 6. The descent and deceleration phases are joined by circular arc path segments.

The remaining phases of the arrival trajectory are handled in a way very closely analogous to that of the departure trajectory. The deceleration phases are each divided into an input number of steps and the descent phases are represented by points at each end. The first point in the deceleration and conversion phase is calculated using the airplane mode deceleration routine.

At all remaining points the conversion and helicopter mode deceleration

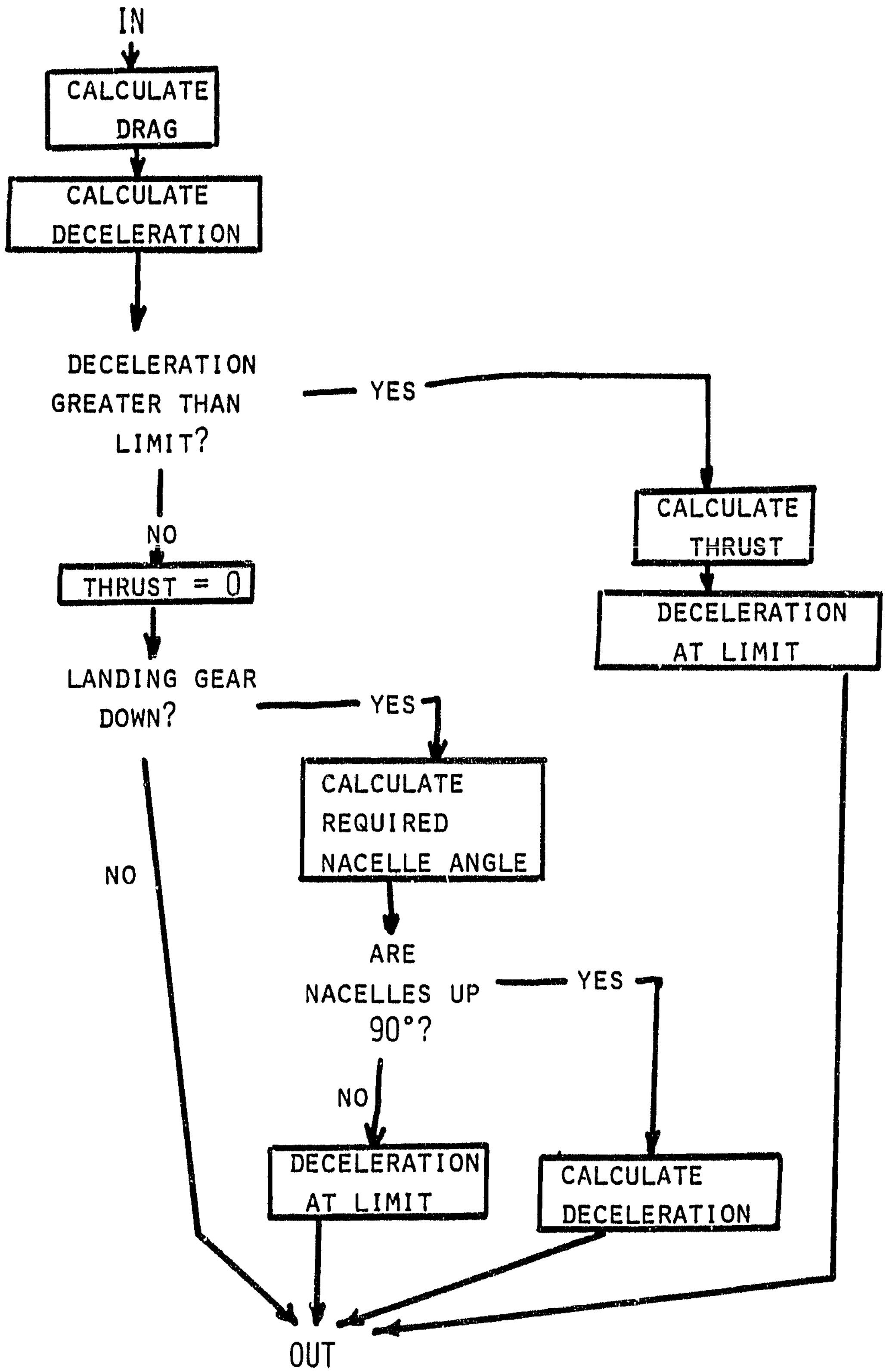


FIGURE 6: FLOW CHART FOR AIRPLANE MODE DECELERATION

routine shown in Figure 7 is applied, whether or not there is deceleration. The pitch altitude is kept constant at the value required to keep wing lift equal to weight at the first point of the phase throughout the deceleration and conversion phase. During the circular arc that follows the aircraft is pitched down to obtain the input maximum downward fuselage angle, and this altitude is held through to hover. During the final vertical descent the aircraft is rotated to 3° nose up for landing. The minimum practical power during conversion and helicopter mode phases is assumed to be 20 percent of the induced power in hover, following Reference 2. Flap deflection is scheduled according to dynamic pressure, being 0° at 250 knots indicated airspeed and 90° at 0 knots.

3.3 Noise Measure

The noise measure used in this work is essentially the same as employed in a previous study on this topic (Ref. 16). Predicted noise output (Sound Pressure Level) is referenced to points on the ground allowing for absorption and attenuation. Time and octave band distributions are combined to form loudness. EPNdb is the best generally accepted measure for comparing noise of different types. EPNdb is converted by the following formula to annoyance:

$$\text{annoyance} = 10^{(\text{EPNdb} - \text{background})/33.2}$$

The annoyance over a surrounding population is summed for both departure and landing to calculate the total noise impact.

This annoyance measure is based on the following principles:

1) a noise 10 db louder is twice as annoying

2) a noise quieter than the background level produces no annoyance

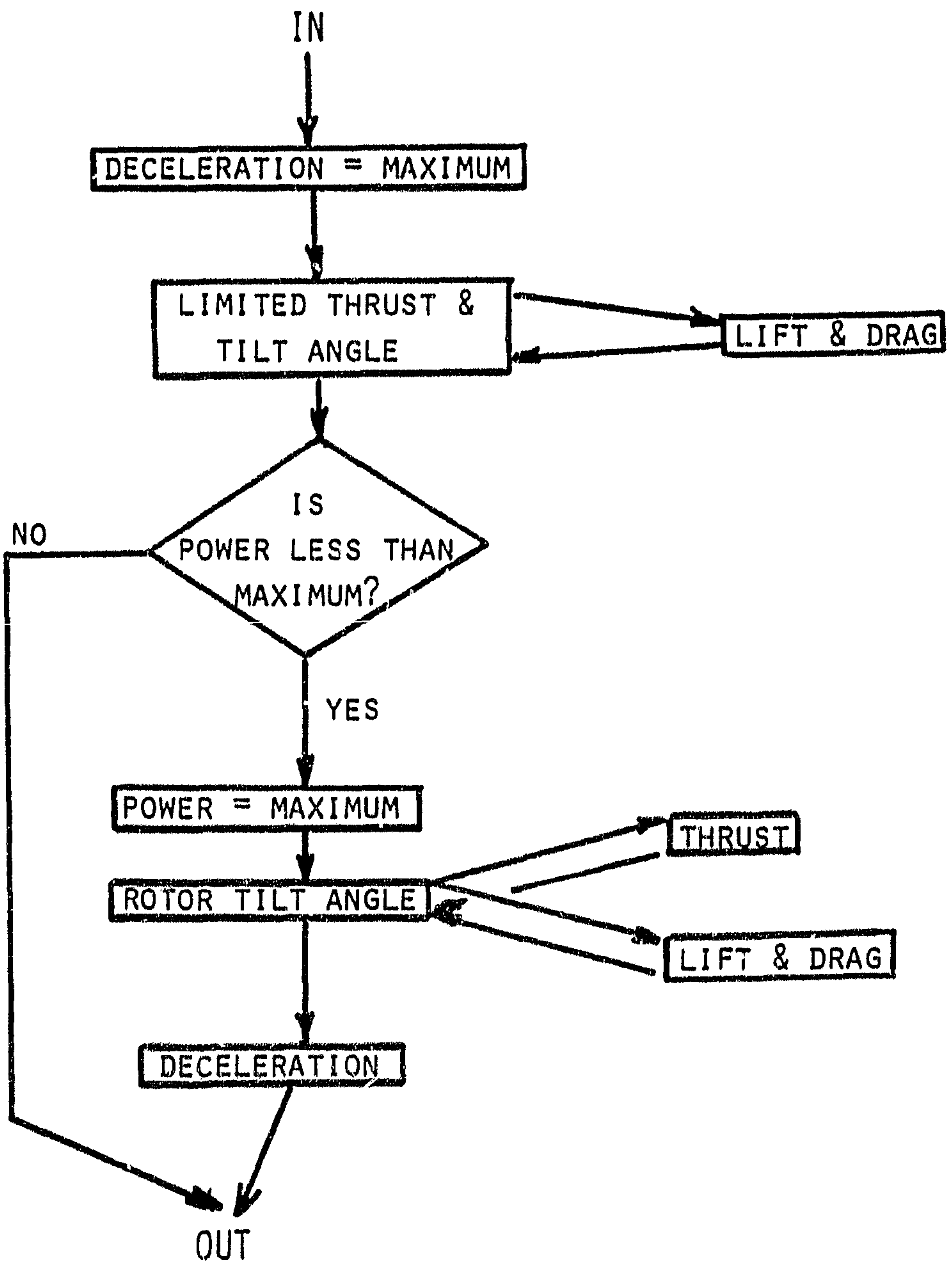


FIGURE 7: FLOW CHART FOR CONVERSION AND HELICOPTER MODE DECELERATION ROUTINE

3) the total annoyance resulting from two people listening to a noise is twice the annoyance of one person listening to the same noise.

Figure 8 shows the small airport and the buffer zone included in the analysis. Otherwise a constant population distribution is assumed. If nine out of ten vertiport sites had an approach free from residential population then different ground population assumptions would be appropriate. Different vehicle designs would result.

3.4 Noise Prediction Techniques

3.4.1 Tactical Approach

A detailed calculation of the noise at 300 different time intervals for 9 octave bands at 1300 ground reference points did not appear practical. Instead, interpolation was used between detailed calculations which covered variations in distance, viewing angle, closing speed, and thrust. Interpolation was not linear, but rather associated with functional shapes appropriate to the phenomena. Accuracy within one or two decibels was generally attained, with greater errors occurring only in extreme cases for the noisiest vehicle.

3.4.2 Noise Prediction Formula

Vortex noise was predicted in the same manner as in the previous work (Ref. 16). The sound pressure level formula was derived from Schlegel et al. (Ref. 10):

$$L_p = 10 \log \frac{7.62 \times 10^{-2} T^2 (V_{tip})^2}{\rho^2 A_b} \quad \text{at 300 feet.}$$

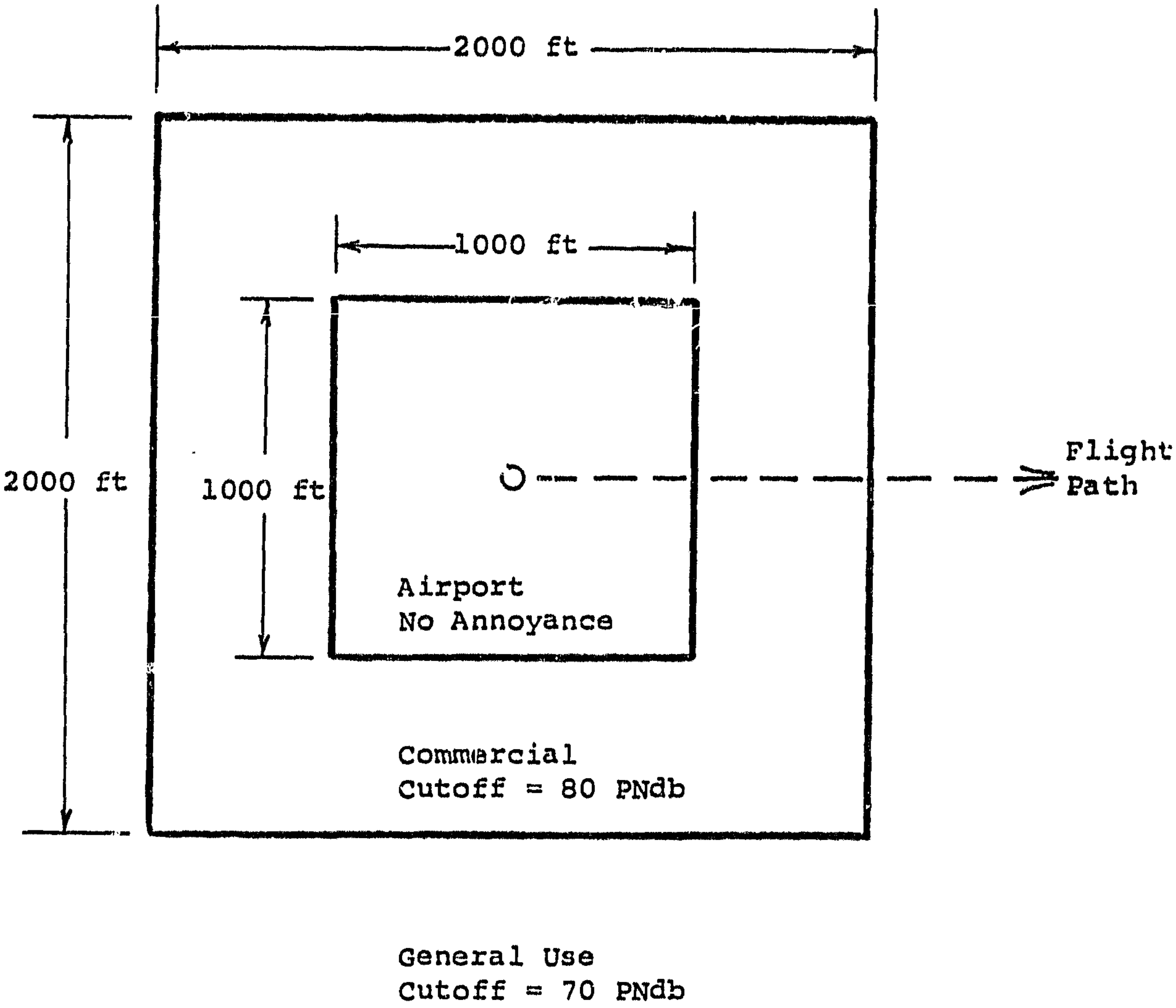


Fig. 8 Land use plan

Peak frequency was calculated by:

$$f_{peak} = V_{tip}/c$$

Directionality was calculated by the formula:

$$DIR = 10 \log_{10} \frac{\cos^2\phi + 0.1}{0.21}$$

Rotational noise was found to be significant for the lower octaves in all designs. The prediction method was developed entirely from the work of Ollerhead and Lowson (Ref. 9). The appendix to Reference 9 provides a graphical method for predicting the sound at several harmonics of the blade passing frequency. The sound pressure level is

$$SPL = I_n + 10 \log_{10} \frac{T\sigma}{R^2}$$

where I_n is a value obtained from Figure 29 of Reference 9 using the appropriate viewing angle and effective blade Mach number.

Following the lead of Ollerhead and Lowson in Reference 9, no change in the fall off of SPL with harmonic number was made for changes in advance ratio. Although there is little knowledge of the exact nature of the decrease of rotational noise with greater advance ratios, it is generally assumed that this phenomenon exists. Although Schmit, Stepniewski, et al. (Ref. 2) have presented one correction on the basis of the available evidence, it was not employed in the current work. First, the correction is small for the range of operations in this work. Second, the correction is smallest for the lower harmonics of blade loadings. In the tilt rotor designs studied, vortex noise dominates the higher harmonics, so errors in rotational noise in these frequencies are unimportant.

3.4.3 Minimum Noise Levels

It appears from work by Widnall (Ref. 11) and also by Leverton (Ref. 18)

as well as unpublished experimental data at M.I.T., that below thrust levels in the neighborhood of 70% of design thrust, noise levels do not decrease with thrust. Widnall bases this cutoff on blade C_L. Noise levels experienced in this condition are a combination of vortex and rotational noise. No information as to the relative importance of the two is available. The conditions at the cutoff thrust level were used for all lesser thrust level in this study.

Vortex noise at zero thrust would seem to come from drag, and rotational noise from higher order loadings, which are not zero even when the mean thrust is zero.

The formula suggested by Reference 11 for the minimum thrust is:

$$T_{min} = 1.5 \times A_b \, (V_{tip}/100)^2$$

3.4.4 Blade Slap

When blade slap exists, it is the dominant noise pattern for existing helicopters. Unfortunately, while crude prediction methods exist for vortex and the lower levels of rotational noise, there are no good estimates of levels of noise from blade slap.

The noisiest design studied here most probably experiences blade slap in descent. The quieter designs may well avoid it due to drastically reduced tip speeds. In any case blade slap is so loud and so annoying that it is unlikely that any commercial tilt rotor vehicle will operate which produces this phenomenon. The ground rules for the study eliminated blade slap from consideration, and no attempt to predict the noise from blade slap was made.

4.0 Study Method and Ground Rules

4.1 Variations

The basic variation consisted of five aircraft designs of 1980 time frame having 50 seats. These vehicles ranged across the spectrum of possible noise levels, from completely unconstrained to the quietest vehicle that could be designed within the study ground rules. The aircraft designs generated in this study are designated by codes consisting of a letter mnemonic indicating the noise class, a number indicating the time frame and a number indicating the size in terms of passenger seats. The noise goals that were used for design optimization were in terms of total annoyance calculated by the computer program. The goals are arranged so that adjacent designs differ in annoyance by about a factor of five. The basic variation aircraft and their noise goals are shown in Table 3. The parameters that were varied to find the minimum DOC aircraft for each noise goal are shown in Table 4, along with the approximate range over which they were varied. The final optimal values of these parameters are given in Table 10, section 5.

In size the basic variation was repeated for sizes of 20, 80 and 110 seats. The gross weight did not converge for S-80-110, as discussed in Section 5, so it is not included here. In time the basic variation was repeated for time frames of 1975 and 1985. In this study, the time frame is intended to be the year of initial prototype flight testing, with airline service following two to five years later. The values of the parameters which were changed to produce the size and time frame variations are given in Tables 5 and 6, respectively. The 1975 values of the parameters used in the time frame variation are based on the calibration of the computer program as discussed in Section 2. The 1980 and 1985 values were derived extrapolating historical trends and knowledge of projected technological developments. The optimality

Table 3 Basic Variation Noise Ranges

Designation	Mnemonic	Approximate Noise Range Arbitrary Units
C-80-50	Conventional	Unconstrained
M-80-50	Modern	9
Q-80-50	Quiet	3
D-80-50	Double Quiet	1.5
S-80-50	Silent	Minimum

Table 4 Design Optimization Parameters

Parameter	Units	Range
Cruise Speed	mph	260-425
Disc Loading	lbs/ft^2	5.5-14
Helicopter Mode Tip Speed	ft/sec	350-850
Airplane Mode Tip Speed	ft/sec	350-600
Wing Loading	lbs/ft^2	50-100
Conversion Power Factor*		1.20-1.70

* Ratio of power desired in conversion to that required in a normal hover.

Table 5 Design Parameters Varied with Size

Parameter	20	50	80	110
Cabin Crew	0	1	2	3
Fuselage Length, ft.	55	80	95	110
Fuselage Diameter, ft.	8.5	10	11.5	13

Table 6 Design Parameters Varied with Time Frame

Parameter	1975	1980	1985
Rotor Hover Efficiency	0.83	0.85	0.87
Rotor Conversion Efficiency	0.81	0.83	0.85
Specific Fuel Consumption, lb/hp. hr.	0.42	0.40	0.38
Airframe Weight Technology Factor	0.80	0.78	0.76
Rotor Weight Technology Factor	1.05	1.00	.95
Drive System Weight Technology Factor	0.85	0.83	0.81
Engine Power/Weight, hp/lb	7.0	8.5	10.0

of the values of the optimization parameters found in the basic variation was checked by varying each of these parameters singly for extreme points of the size and time frame variations, namely C-75-20, C-80-110, S-80-50, C-75-50, and S-85-50, S-75-50, and S-85-50. No significant improvements could be found so these parameters were kept constant for each noise class throughout the size and time frame variations.

In all the previous variations the departure obstacle clearance path was kept fixed at 60° to 100 feet. In order to assess how this choice of path might affect the results, the departure obstacle clearance path was varied. Eight other departure paths were considered with obstacle heights of 50, 100 and 200 feet and obstacle clearance angles of 30°, 60° and 90°. It was found that the basic variation aircraft did not have sufficient power in the conversion phase to execute the departure paths having greater obstacle heights or steeper obstacle clearance angles. The reason for this is the assumption in the departure path calculation that the vertical speed built up in the obstacle clearance phase is maintained through the acceleration and conversion phase. The higher paths require that conversion be executed while maintaining a greater vertical speed requiring extra power which the basic variation aircraft do not have. Therefore the path variation was accomplished using a more powerful aircraft, QP-80-50. This design is similar to Q-80-50 but the conversion power factor has been increased from 1.40 to 2.00.

Finally a hovering case was run to develop a standard level of total annoyance. A vehicle was found which generated 95.0 PNdB at 500 ft. distance while hovering at 100 ft. altitude. This is approximately the noise level of the Vertol 347 helicopter. Then this vehicle was hovered over the center of the vertiport for one minute at 100 ft. altitude to obtain a standard level of total annoyance. All gross levels of annoyance produced by other vehicles were divided by this value to obtain relative annoyance, which is used for all plots.

4.2 Constraints

Several constraints, which are external to the computer program, were obeyed during the variations described above. A rotor solidity of 0.25 was considered the arbitrary maximum.. The wing aspect ratio was kept below 8.0 to avoid aeroelastic problems. The wing loading was kept above 50 to permit reasonable ride quality. Finally the conversion speed was not permitted to be less than two thirds of the airplane mode best rate-of-climb speed, in order to have an adequate conversion corridor.

4.3 Constants

The values of significant constants which were used throughout the study are shown in Tables 7, 8, 9 and 10. Complete data on all the aircraft designs discussed in this report is presented in Appendix 1. Direct operating cost was calculated at a variety of stage lengths. The cost over two 200 mile segments, with the engines not shut down at the intermediate stop, was selected as representative of typical high-density short haul operations. DOC is in 1973 dollars.

Table 7 Design Constants

Parameter	Value
Design Range, stat. mi.	500
Cruise Altitude, ft.	15,000
Max. Helicopter Mode Advance Ratio	0.40
Wing Thickness/Chord Ratio	0.21
Wing Taper Ratio	0.70
Flap Area/Wing Area	0.25
Wing Max. Clean Lift Coefficient	1.40
Number of Engines	2
Emergency/Normal Power	1.40
Climb/Normal Power	1.20
Cruise/Normal Power	0.90
Field Elevation, ft.	0
Emergency Hover Altitude, ft.	2000
Maximum Acceleration, g.	0.25
Maximum Deceleration, g.	0.20
Hot Day Temperature, ^{o}F.	95
Standard Day Temperature, ^{o}F	59

Table 8 Operating Cost Constants

Parameter	Value
Utilization, hr./yr.	2000
Depreciation Period, yr.	10
Residual Value, %	0
Airframe Cost, $/lb.	80
Engine Cost, $/hp.	60
Fuel Cost ¢/gal.	18
Hull Insurance Rate, % per yr.	4.0
Maintenance Labor Rate, $/hr.	7.00

Table 9 Departure Path Constants

Parameter	Value
Max. Fuselage Pitch Angle, deg.	20
Max. Accel. Vector Rotation Rate, deg./sec.	20
Acceleration Buildup Time, sec.	5
Obstacle Clearance Angle, deg.	60*
Obstacle Clearance Height, ft.	100*

*Except in Path Variation

Table 10. Arrival Path Constants

Parameter	Value
Max. Downward Fuselage Pitch Angle, deg.	10
Deceleration Buildup Time, sec.	5
Altitude of Airplane Mode Deceleration, ft.	3000
Altitude of Deceleration and Conversion, ft.	1500
Speed at End of Airplane Mode Deceleration, kt.	200
Final Approach Speed, kt.	60
Final Approach Path Angle, deg.	8

5.0 Results and Discussion

5.1 Overview

A very small sacrifice in direct operating cost can reduce the annoyance of tilt rotor vehicle operations from a quite substantial level to a very modest amount. However, eliminating all annoyance is technically very difficult and simultaneously quite expensive. Silent designs, when possible, represented a 30% increase in DOC.

Figure 9 illustrates this relationship for fifty seat vehicles in the 1980 time frame. The conventional, modern, quiet, and double quiet vehicles (C, M, Q, and D respectively) have almost the same cost. Yet, the annoyance ranges from 25 to 1.

Table 11 describes more completely the vehicles under discussion. The process of quieting is to reduce disc loading and hover tip speed. Even though the arrival sideline noise is several decibels below that of departures, arrival annoyance is the greater number due to the lower flight angle and subsequent longer footprint on arrival.

There is little change in the relationship with changes in technology level as represented by the year of first prototype. Figure 10 shows identical curves for the different time frames, although displaced by approximately $1.00 per seat trip which is saved on each vehicle by the changes in weights and efficiencies.

Small vehicles tend to be quite expensive, as well as a little noisier than large vehicles of similar deisgn. Figure 11 suggests that vehicles with 80 seats have attained most of the economies of vehicle size which might be available without creating excessive amounts of noise.

It must be noted that large vehicles of very quiet design (the S-80-110

FIGURE 9: BASIC VARIATION, DOC VS RELATIVE ANNOYANCE

1980 TIME FRAME

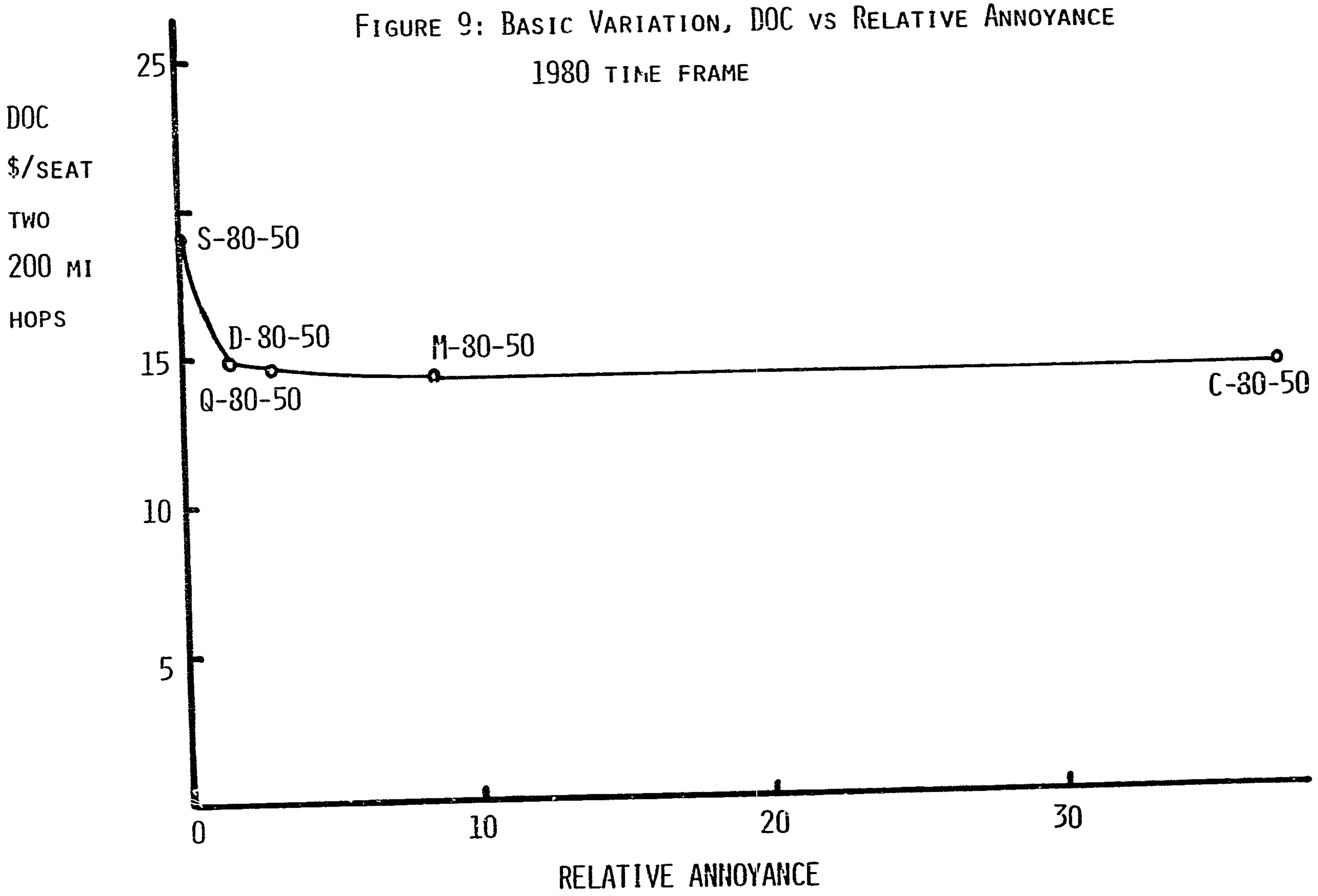


Table 11. Charactersitics of Basic Variation Aircraft

	C	M	Q	D	S
EPNdb @500' Sideline					
Departure	107.6	99.4	93.8	91.1	80
Arrival	105.7	94.5	91.0	87.6	80
Relative Annoyance					
Departure	16.6	3.22	.86	.40	0
Arrival	20.9	5.61	2.15	1.14	.021
Total	37.5	7.72	3.00	1.55	.021
DOC, $/Seat Trip for Two 200 Mile Trips	14.20	14.29	14.02	14.99	19.07
Disc Loading lbs/ft^2	13.0	10.0	8.5	7.0	5.5
Radius	22.9	26.2	28.7	32.0	39.3
Solidity	0.093	0.093	0.098	0.087	0.174
Tip Speed, hover	800	700	630	607	380
Tip Speed, cruise	570	550	540	540	380
Wing Loading	102	84.0	72.0	62.0	52
Cruise Speed	446	427	411	401	323
Gross Wt	42883	43006	44115	45116	53479
Fuel Wt	4430	3921	3746	3633	3795
Cruise L/D	9.78	9.91	9.93	9.94	13.15
Number of Blades	3	3	3	3	6
Conversion Power Factor	1.3	1.25	1.4	1.4	1.5

Aspect ratio = 8.0; Payload = 10,500 lbs; Capacity = 50 seats

FIGURE 10: TIME FRAME VARIATION

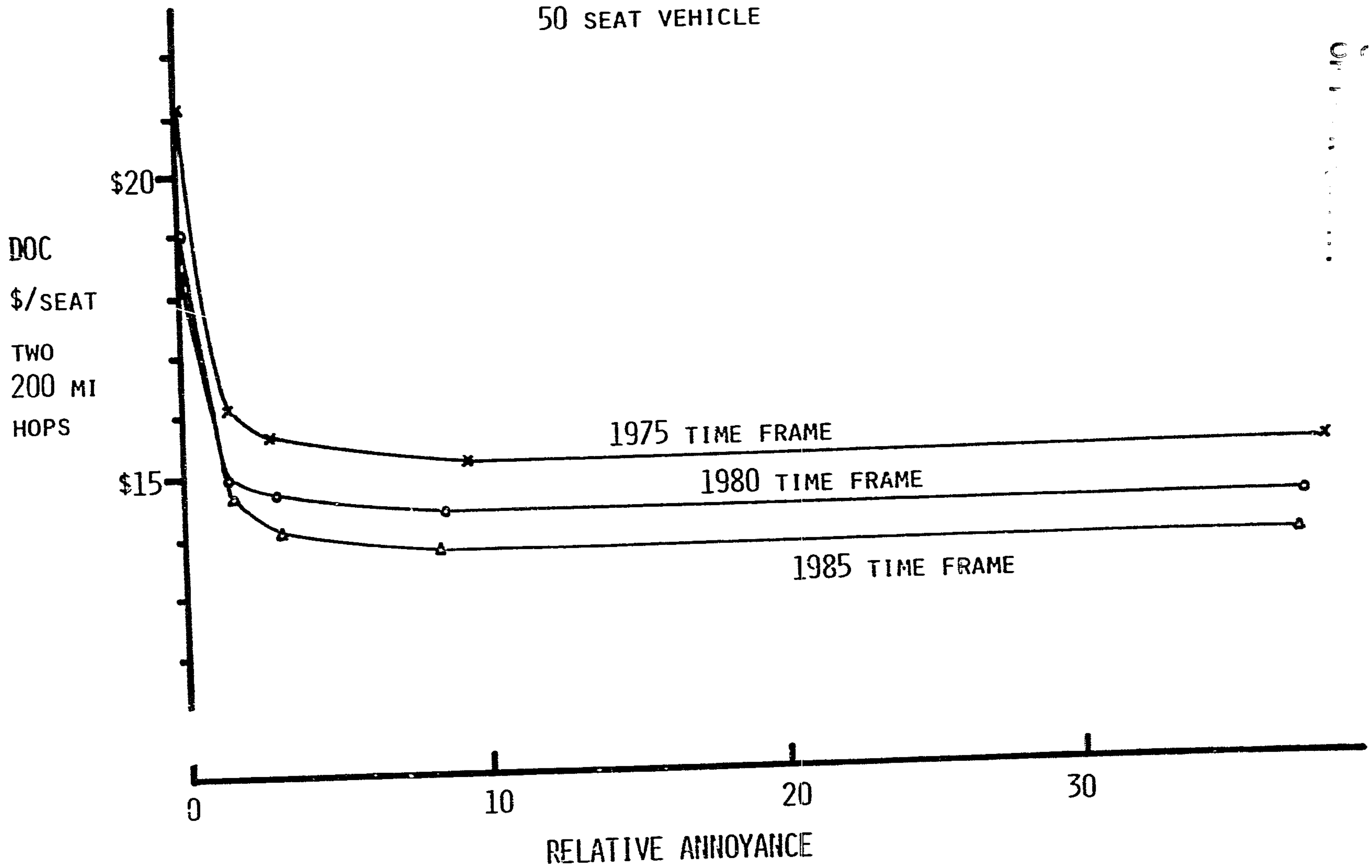
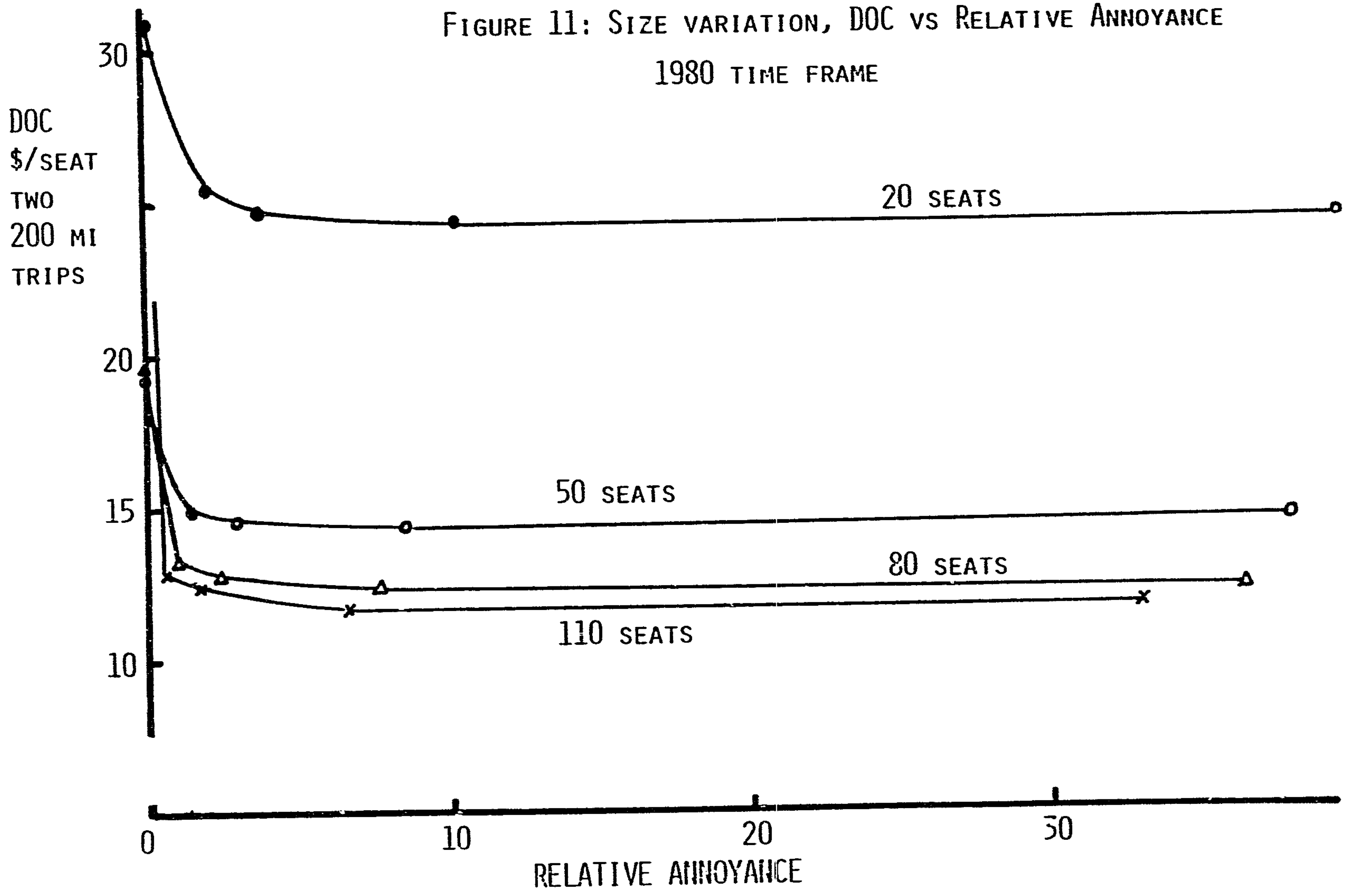


FIGURE 11: SIZE VARIATION, DOC VS RELATIVE ANNOYANCE

1980 TIME FRAME



vehicle) may be impossible. The design program increases structural weight with increases in gross weight. The large and heavy rotors on this S vehicle cause structural weight increases. This increased the gross weight without bound. It is this effect, basically an example of the cube-square law, which forces the bend upward in the total operating cost line for silent vehicles in Figure 12. Otherwise, total operating cost seems to be linear with size.

5.2 The Quiet Designs

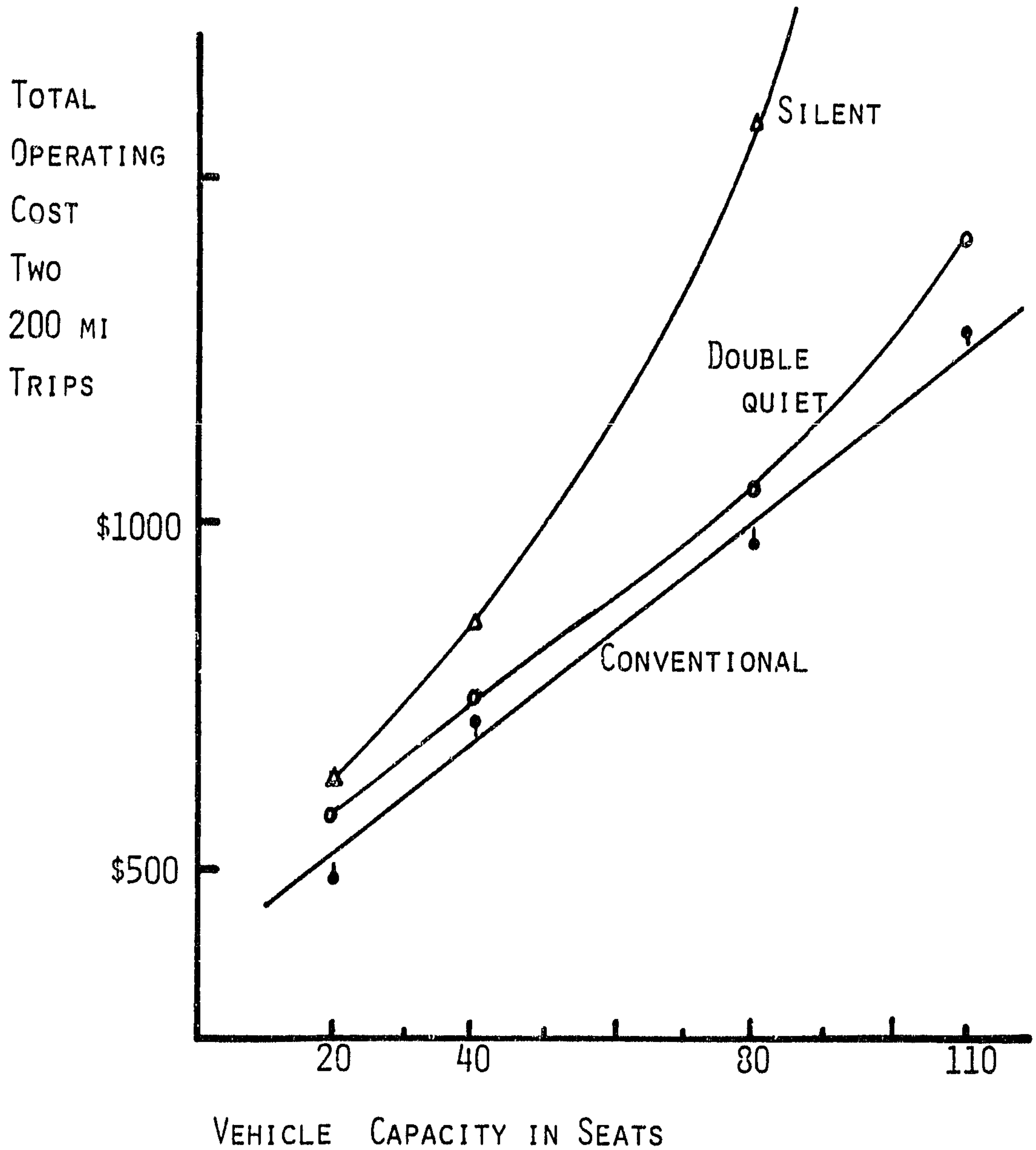
The basic mechanism for quiet tilt rotor designs is a reduction in the hover and tip speed. This has the effect of reducing both vortex and rotational noise. The lower blade passing frequencies also push the rotational noise into the lower ranges of human hearing, where people do not hear as well. Table 11 shows that hover tip speeds are reduced from 800 to 600 feet per second.

The other major modification is a steady reduction in disc loading. The combination of this and the tip speed reduction requires larger and heavier rotors, which increases costs. However, improved cruise and hover efficiencies compensate somewhat for the slower and heavier vehicles, and the cost rise is not severe.

The constraints on wing design are: 1) the aspect ratio should not rise above 8, to assure structural roundness; and 2) that the tip rotors clear the fuselage by a foot. These rules drive the quieter designs to larger wings and lower wing loadings as noted in Table 11. This is a consequence rather than an objective of the quieting process.

As tip speeds in hover are reduced, a modest reduction in cruise tip speeds is useful, along with a minor sacrifice in cruise speed. These

FIGURE 12: TOC VS VEHICLE SIZE FOR VEHICLES OF APPROXIMATELY THE SAME NOISE LEVELS



tradeoffs are in part controlled by the growth of the wing, which forces slower cruise speeds even at some sacrifice in cruise times and thus DOC.

The number of blades in all designs is at a minimum, and the noise for increased numbers of blades would be much higher. Any increase in blades increases the blade passing frequency, which drives rotational noise upward toward sensitive aural ranges. In order to avoid this effect, no increase in solidity is sought as vehicles become quieter. This is counter to the tradeoffs dependent entirely on vortex noise as given by Reference 16.

It is this same reduction in blade passing frequency in the larger designs which explains the very minor reduction in noise annoyance of larger vehicles. Apparently, it more than makes up for the increase in thrust.

5.3 Characteristics of the Annoyance

The annoyance on approach is far greater than that of departure, particularly for the quieter designs, because the low approach path exposes more ground area to noise. The modest changes in departure annoyance with flight path that are illustrated in Figure 13 do not have a large influence on the total annoyance, or the DOC.

From a systems view the noise per seat can be made quite small for the larger designs. It would appear that a quiet or double quiet design in the 80 passenger range can be both economical and quiet. While the 110 passenger design is quieter still, its use would reduce frequency of service. The noise per seat is illustrated in Figure 14. This statistic is somewhat misleading, since it is usually impractical to substitute one large aircraft for two departures of smaller aircraft.

It is interesting to note that annoyance, measured as the sum of the number of people annoyed weighted by the degree of annoyance, is sensitive to only

FIGURE 13: FLIGHT PATH VARIATION

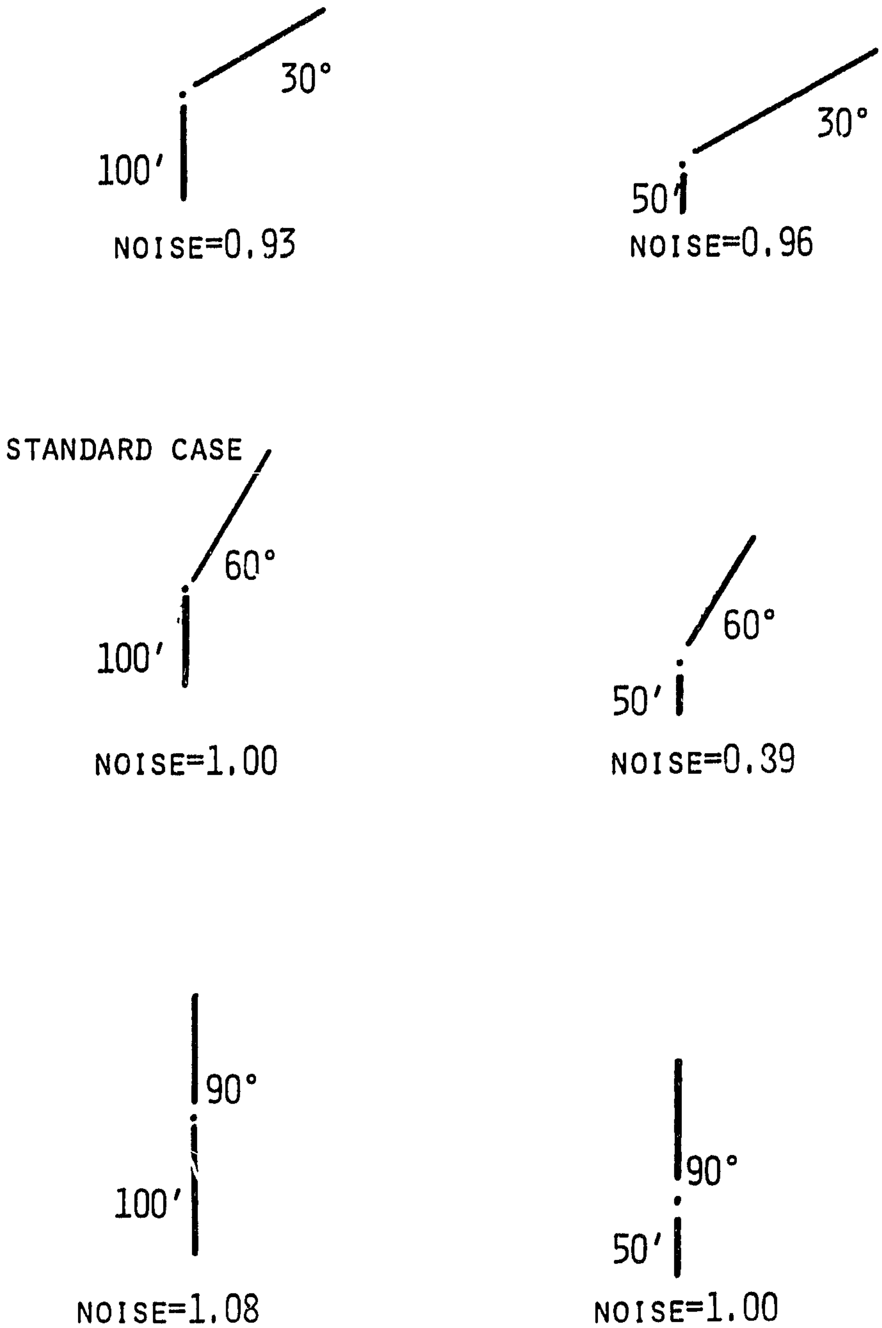
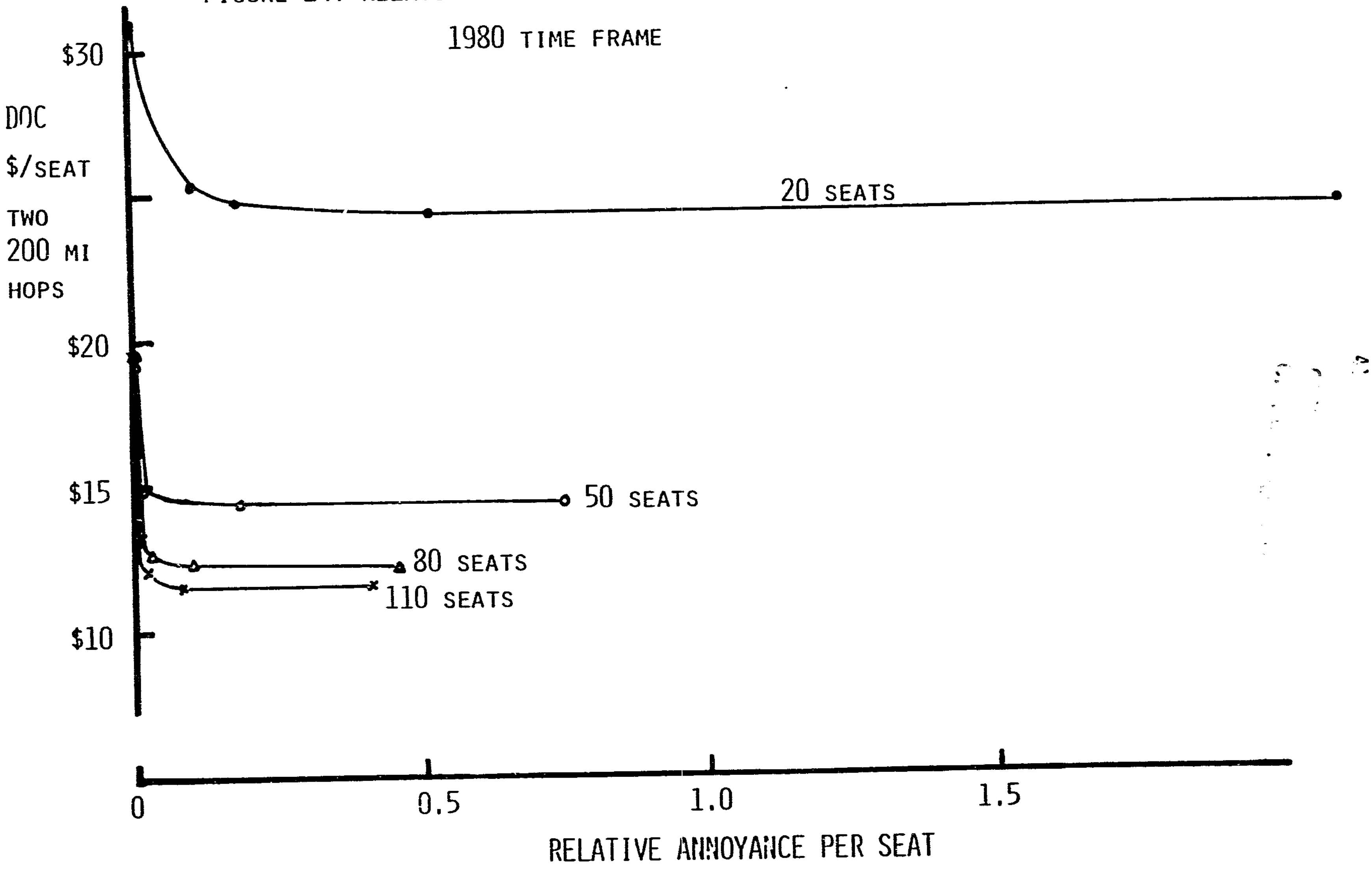


FIGURE 14: RELATIVE ANNOYANCE PER SEAT

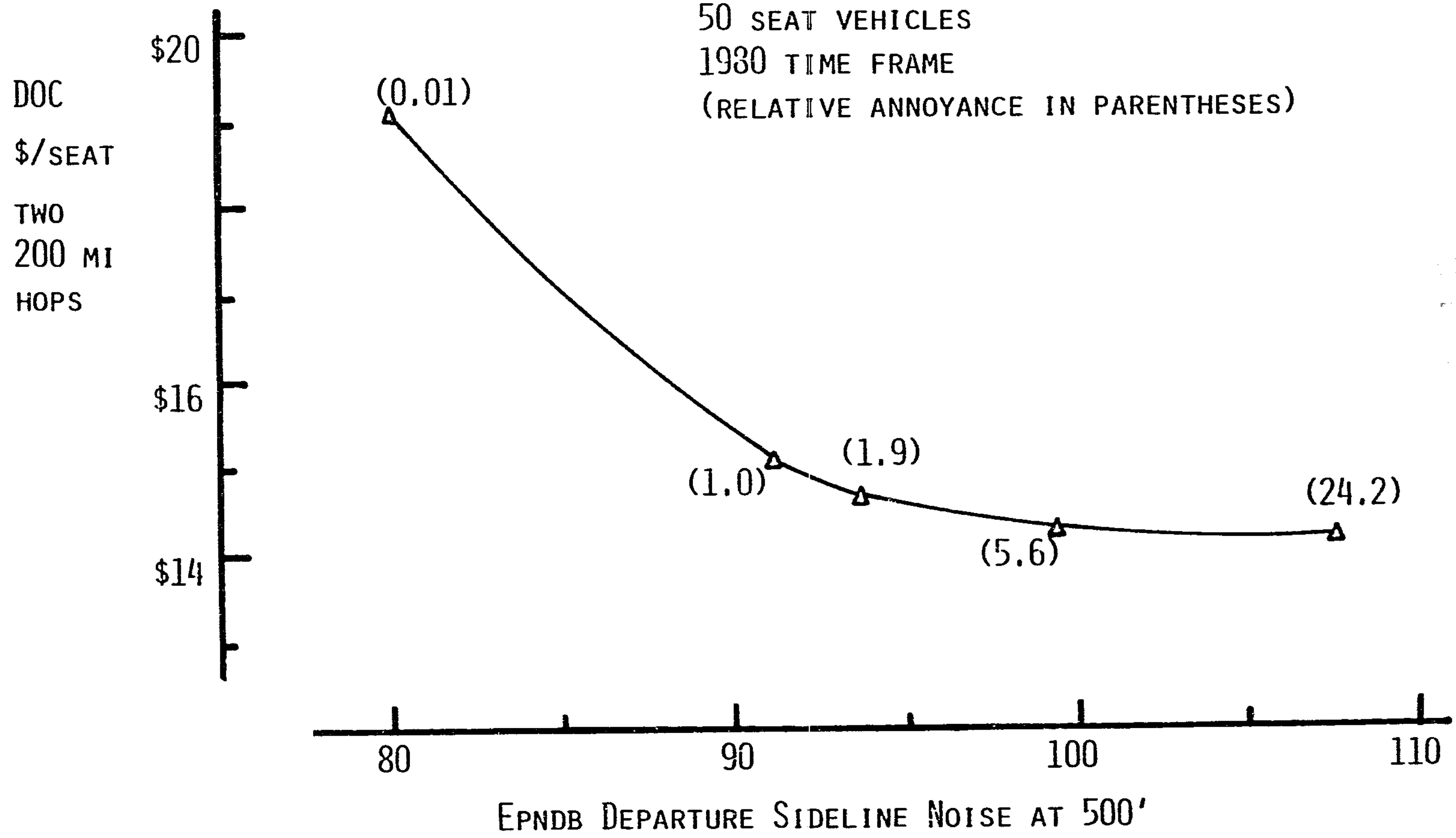
1980 TIME FRAME



modest reductions in sideline noise measurements. Figure 15 shows relative annoyances being reduced by one quarter when noise at the sideline is halved (reduced by ten decibels).

Figure 15: DOC vs Sideline Noise

50 seat vehicles
1980 time frame
(relative annoyance in parentheses)



6.0 Conclusions

Preliminary design studies suggest that the noise annoyance of commercial tilt rotor vehicle operations can be either substantially reduced or nearly eliminated. Significant reductions in tip speeds and disc loadings appear to be possible without undue sacrifices in operating costs. The resulting noise levels are not much above background noise levels for reasonable departure and arrival trajectories.

Table 12. "Conventional' Venicle Designs (c)

	1980				50 seats	
	20	50	80	110	1975	1985
DOC per seat, two 200 mi. hops:	$24.12	$14.20	$12.11	$11.70	$15.12	$13.65
DOC per seat mile	0.0421	0.0250	0.0213	0.0208	0.0266	0.0241
DOC per seat departure	3.35	1.90	1.63	1.57	2.04	1.83
Total Annoyance	45.2	37.5	36.4	33.1	38.4	37.3
departure "	28.2	16.6	17.1	16.1	16.7	15.8
arrival "	27.0	20.9	19.4	17.0	21.7	21.5
EPNdb at 500' sideline						
departure	108.3	107.6	107.7	107.6	107.4	107.3
arrival	106.8	105.7	105.8	105.7	105.8	105.9

Table 13. "Modern" Vehicle Designs (M)

	1980				50 seats	
	20	50	80	110	1975	1985
DOC per seat, two 200 mile hops:	$24.28	$14.29	$12.19	$11.74	$15.18	$13.74
DOC per seat mile	0.0429	0.0255	0.0217	0.0209	0.027	0.0246
DOC per seat departure	3.25	1.85	1.57	1.51	1.96	1.77
Total Annoyance	10.25	8.81	7.72	6.70	8.59	9.58
departure "	3.4	3.22	2.8	2.5	3.3	3.5
arrival "	6.8	5.61	4.9	4.2	5.3	6.1
EPNdb at 500' sideline						
departure	99.9	99.4	99.6	98.1	99.4	100.1
arrival	97.5	94.5	93.9	93.6	94.1	96.6

Table 14. "Quiet" Vehicle Designs (Q)

	1980				50 seats	
	20	50	80	110	1975	1985
DOC per seat, two 200 mile hops:	$24.64	$14.62	$12.66	$12.21	$15.60	$14.10
DOC per seat mile	0.044	0.0265	0.0229	0.0220	0.0281	0.0255
DOC per seat departures	3.21	1.81	1.57	1.52	1.95	1.76
Total Annoyance	3.79	3.00	2.31	1.76	2.93	3.11
departure "	1.1	0.86	0.7	0.6	1.01	1.0
arrival "	2.6	2.15	1.6	1.2	1.9	2.1
EPNdb at 500' sideline						
departure	94.4	93.8	92.5	91.6	93.6	98.9
arrival	91.4	91.0	89.0	87.8	90.5	90.8

Table 15. "Double Quiet" Vehicle Designs (D)

	1980				50 seats	
	20	50	80	110	1975	1985
DOC per seat, two 200 mile hops:	$25.37	$14.99	$13.12	$12.84	$16.10	$14.62
DOC per seat mile	0.0454	0.0273	0.0239	0.0233	0.0291	0.0265
DOC per seat departure	3.27	1.82	1.58	1.55	1.97	1.81
Total Annoyance	2.05	1.55	1.04	0.61	1.51	1.56
departure "	0.5	0.40	0.3	0.2	0.4	0.5
arrival "	1.5	1.14	0.7	0.4	1.1	1.1
EPNdb at 500' sideline						
departure	91.7	91.1	89.4	88.3	90.8	91.0
arrival	88.1	87.6	85.2	83.9	87.2	87.4

Table 16. "Silent" Vehicle Designs (5)

	1980				50 seats	
	20	50	80	110	1975	1985
DOC per seat, two 200 mile hops:	$30.93	$19.07	$19.80	∞	$18.43	$21.13
DOC per seat mile	0.0592	0.0366	0.0384	-	0.0406	0.0356
DOC per seat departure	3.20	1.96	1.98	-	2.17	1.85
Total Annoyance	0.0405	0.021	0.004	-	0.025	0.020
departure "	0	0	0	-	0	0
arrival "	0.045	0.021	0.004	-	0.025	0.020
EPN db at 500' sideline						
departure	75.8	< 80	< 80	-	< 80	< 80
arrival	72.1	< 80	< 80	-	< 80	< 80

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Appendix 1: Computer Output for All Designs

TILT ROTOR DESIGN PROGRAM 1974

C-80-20

DESIGN ITERATIONS: 3

OVERALL	
GROSS WEIGHT (LB)	19654.
EMPTY WEIGHT (LB)	13336.
FUEL WEIGHT (LB)	2318.
PAYLOAD (LB)	4000.
CRUISE SPEED (MPH)	441.
L/D CRUISE	8.33
*RANGE (STAT MI)	500.
*PASSENGER SEATS	20.
*CARGO (LB)	0.

ROTORS	
*DISC LOADING (PSF)	13.00
RADIUS (FT)	15.5
SOLIDITY	0.087
BLADE CHORD (FT)	1.42
TOTAL BLADES	6
*CT/SIG HOVER	0.120
*PROFILE DRAG COEFF	0.010
% DOWNLOAD	9.3
*EFFICIENCY HOVER	0.85
* CONVER	0.83
CRUISE	0.75
HEL MODE WEIGHT (LB)	1432.
AIRPLANE WEIGHT (LB)	1153.
*TIP SPEED HOVER	825.
* CRUISE	570.
*FUSELAGE CLEARANCE (FT)	1.0
*MAX HEL MODE ADV RATIO	0.40

POWERPLANT	
INST NORMAL PWR (HP)	5195.
*NUMBER OF ENGINES	2.
*EXCESS FACTOR HEL MODE	1.35
*% RATED EMRG HVR	140.
* CONV + CLIMB	120.
* CRUISE	90.
INST PWR EMRG HVR (HP)	4490.
CONVER (HP)	3290.
CRUISE (HP)	5195.
*SFC (LB/HP HR)	0.400

DRIVE SYSTEM	
*EFFICIENCY	0.97
HEL MODE WEIGHT (LB)	1278.
AIRPLANE WEIGHT (LB)	1648.

WING	
AREA (SF)	[illegible]
*LOADING (PSF)	102.0
ASPECT RATIO	8.95
SPAN (FT)	41.5
MEAN CHORD (FT)	4.64
*THICKNESS/CHORD RATIO	0.210
*TAPER RATIO	0.70
SWEEP (DEG)	-5.1
CRUISE LIFT COEFF	0.33
MAX LIFT COEFF CONVER	0.83
*MAX LIFT COEFF CLEAN	1.40
*FLAP AREA/WING AREA	0.25
CLIMB SPD/CONVER SPD	0.71

FUSELAGE	
*LENGTH (FT)	55.0
*DIAMETER (FT)	8.5
*DRAG FACTOR	1.00

FLAT PLATE AREAS (SF)	
WING PROFILE	1.38
FUSELAGE	3.34
EMPENNAGE	0.83
TOTAL PROFILE	6.72
WING INDUCED	0.81

COMPONENT WEIGHTS (LB)	
ROTORS	1432.
DRIVE SYSTEM	1848.
POWERPLANT	917.
NACELLES	59.
FUEL SYSTEM	128.
WING	1233.
FUSELAGE	2699.
EMPENNAGE	383.
LANDING GEAR	590.
FLIGHT CONTROLS	602.
HYDRAULICS	181.
ELECTRICAL	221.
INSTR+AVIONICS	580.
AIR CONDITIONING	760.
FURNISHINGS	1300.
FLUIDS	98.
FLIGHT CREW	400.
CABIN CREW	0.

STRUCT TECHNOLOGY FACTORS	
*ROTOR	1.00
*TRANSMISSION	0.83
*AIRFRAME	0.78
*ENGINE (HP/LB)	8.50
*ENGINE INSTALLATION	1.50

DESIGN MISSION	
*FIELD ELEVATION (FT)	0.
SOUND SPEED HVR (FPS)	1117.
*STD DAY TEMP (DEG F)	59.
*EMERG HOVER ALT (FT)	2000.
*HOT DAY TEMP (DEG F)	95.
*CT/SIG MAX	0.150
*MAX ACCELERATION (G)	0.25
*DESIGN CRUISE (MPH)	440.
*CRUISE ALTITUDE (FT)	15000.
SOUND SPEED CRSE (FPS)	1058.
*MAX DECELERATION (G)	0.20
*STRUCT LOAD FACTOR	4.5
*FLIGHT CREW	2.
*CABIN CREW	0.
*ATC SPEED LIMIT	YES

* INDICATES INPUT VARIABLE

DESIGN MISSION	SPEED MPH	HEIGHT FT	DIST MI	TIME MIN	FUEL LB
TAKEOFF & LANDING				2.00	43.
ACCEL. & CONV.		1600.	1.6	1.23	32.
AIRPLANE CLIMB	161.,197.	13400.	9.4	3.16	92.
ACCEL. TO CRUISE			11.9	1.98	61.
CRUISE	441.		442.7	60.27	1631.
AIRPLANE DESCENT	441.,301.	12000.	24.4	4.16	17.
APPROACH		3000.	10.0	3.99	17.
TOTAL			500.0	76.79	1893.
RESERVE				20.00	426.

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TILT ROTOR DESIGN PROGRAM 1974

C-80-5J

DESIGN ITERATIONS: 5

OVERALL	
GROSS WEIGHT (LB)	42863.
EMPTY WEIGHT (LB)	28303.
FUEL WEIGHT (LB)	4430.
PAYLOAD (LB)	10150.
CRUISE SPEED (MPH)	446.
L/D CRUISE	9.78
*RANGE (STAT MI)	500.
*PASSENGER SEATS	50.
*CARGO (LB)	0.

ROTORS	
*DISC LOADING (PSF)	13.00
RADIUS (FT)	22.9
SOLIDITY	0.053
BLADE CHORD (FT)	2.24
TOTAL BLADES	6
*CT/SIG HOVER	0.120
*PROFILE DRAG COEFF	0.010
% DOWNLOAD	5.5
*EFFICIENCY HOVER	0.85
* CONVER	0.83
CRUISE	0.74
HEL MODE WEIGHT (LB)	3378.
AIRPLANE WEIGHT (LB)	2700.
*TIP SPEED HOVER	800.
* CRUISE	570.
*FUSELAGE CLEARANCE (FT)	1.0
*MAX HEL MODE ADV RATIO	0.40

POWERPLANT	
INST NORMAL PWR (HP)	5770.
*NUMBER OF ENGINES	2.
*EXCESS FACTOR HEL MODE	1.30
*% RATED EMRG HVR	140.
* CONV + CLIMB	120.
* CRUISE	90.
INST PWR EMRG HVR (HP)	5770.
CONVER (HP)	6890.
CRUISE (HP)	5502.
*SFC (LB/HP HR)	0.400

DRIVE SYSTEM	
*EFFICIENCY	0.97
HEL MODE WEIGHT (LB)	3231.
AIRPLANE WEIGHT (LB)	4267.

WING	
AREA (SF)	420.
*LOADING (PSF)	102.0
ASPECT RATIO	7.95
SPAN (FT)	57.8
MEAN CHORD (FT)	7.27
*THICKNESS/CHORD RATIO	0.210
*TAPER RATIO	0.70
SWEEP (DEG)	-5.3
CRUISE LIFT COEFF	0.32
MAX LIFT COEFF CONVER	0.88
*MAX LIFT COEFF CLEAN	1.40
*FLAP AREA/WING AREA	0.25
CLIMB SPD/CONVER SPD	0.80

FUSELAGE	
*LENGTH (FT)	80.0
*DIAMETER (FT)	10.0
*DRAG FACTOR	1.00

FLAT PLATE AREAS (SF)	
WING PROFILE	2.83
FUSELAGE	5.23
EMPENNAGE	1.70
TOTAL PROFILE	11.81
WING INDUCED	1.52

COMPONENT WEIGHTS (LB)	
ROTORS	3378.
DRIVE SYSTEM	4267.
POWERPLANT	1724.
NACELLES	265.
FUEL SYSTEM	389.
WING	3115.
FUSELAGE	5544.
EMPENNAGE	836.
LANDING GEAR	1237.
FLIGHT CONTROLS	1805.
HYDRAULICS	268.
ELECTRICAL	667.
INSTR+AVIONICS	733.
AIR CONDITIONING	1150.
FURNISHINGS	2500.
FLUIDS	214.
FLIGHT CREW	400.
CABIN CREW	150.

STRUCT TECHNOLOGY FACTORS	
*ROTOR	1.00
*TRANSMISSION	0.83
*AIRFRAME	0.78
*ENGINE (HP/LB)	8.50
*ENGINE INSTALLATION	1.50

DESIGN MISSION	
*FIELD ELEVATION (FT)	0.
SOUND SPEED HVR (FPS)	1117.
*STD DAY TEMP (DEG F)	59.
*EMERG HOVER ALT (FT)	2000.
*HOT DAY TEMP (DEG F)	95.
*CT/SIG MAX	0.150
*MAX ACCELERATION (G)	0.25
*DESIGN CRUISE (MPH)	440.
*CRUISE ALTITUDE (FT)	15000.
SOUND SPEED CRSE (FPS)	1058.
*MAX DECELERATION (G)	0.20
*STRUCT LOAD FACTOR	4.5
*FLIGHT CREW	2.
*CABIN CREW	1.
*ATC SPEED LIMIT	YES

* INDICATES INPUT VARIABLE

DESIGN MISSION	SPEED MPH	HEIGHT FT	DIST MI	TIME MIN	FUEL LB
TAKEOFF & LANDING				2.00	50.
ACCEL. & CONV.		1600.	1.6	1.13	60.
AIRPLANE CLIMB	175.,214.	13400.	12.3	3.80	209.
ACCEL. TO CRUISE			13.5	2.22	129.
CRUISE	446.		434.0	58.36	2978.
AIRPLANE DESCENT	446.,301.	12000.	28.6	4.86	36.
APPROACH		3300.	10.0	3.99	32.
TOTAL			500.0	76.35	3534.
RESERVE				20.00	896.

TILT ROTOR DESIGN PROGRAM 1974

C-80-80 — DESIGN ITERATIONS: 6

OVERALL	
GROSS WEIGHT (LB)	69817.
EMPTY WEIGHT (LB)	46487.
FUEL WEIGHT (LB)	7030.
PAYLOAD (LB)	16330.
CRUISE SPEED (MPH)	462.
L/D CRUISE	10.27
*RANGE (STAT MI)	500.
*PASSENGER SEATS	90.
*CARGO (LB)	0.

ROTORS	
*DISC LOADING (PSF)	13.00
RADIUS (FT)	29.2
SOLIDITY	0.093
BLADE CHORD (FT)	2.86
TOTAL BLADES	6
*CT/SIG HOVER	0.120
*PROFILE DRAG COEFF	0.010
% DOWNLOAD	10.2
*EFFICIENCY HOVER	0.85
* CONVER	0.83
CRUISE	0.73
HEL MODE WEIGHT (LB)	5750.
AIRPLANE WEIGHT (LB)	4604.
*TIP SPEED HOVER	800.
* CRUISE	570.
*FUSELAGE CLEARANCE (FT)	1.0
*MAX HEL MODE ADV RATIO	0.40

POWERPLANT	
INST NORMAL PWR (HP)	15915.
*NUMBER OF ENGINES	2.
*EXCESS FACTOR HEL MODE	1.30
*% RATED EMRG HVR	140.
* CONV + CLIMB	120.
* CRUISE	90.
INST PWR EMRG HVR (HP)	15915.
CONVER (HP)	11224.
CRUISE (HP)	14043.
*SFC (LB/HP HR)	0.400

DRIVE SYSTEM	
*EFFICIENCY	0.97
HEL MODE WEIGHT (LB)	5802.
AIRPLANE WEIGHT (LB)	7658.

WING	
AREA (SF)	685.
*LOADING (PSF)	102.0
ASPECT RATIO	7.57
SPAN (FT)	72.0
MEAN CHORD (FT)	9.51
*THICKNESS/CHORD RATIO	0.210
*TAPER RATIO	0.70
SWEEP (DEG)	-5.3
CRUISE LIFT COEFF	0.30
MAX LIFT COEFF CONVER	0.88
*MAX LIFT COEFF CLEAN	1.40
*FLAP AREA/WING AREA	0.25
CLIMB SEC/CONVER SPD	0.84

FUSELAGE	
*LENGTH (FT)	95.0
*DIAMETER (FT)	11.5
*DRAG FACTOR	1.00

FLAT PLATE AREAS (SF)	
WING PROFILE	4.44
FUSELAGE	6.95
EMPENNAGE	2.66
TOTAL PROFILE	16.99
WING INDUCED	2.85

COMPONENT WEIGHTS (LB)	
ROTORS	5750.
DRIVE SYSTEM	7698.
POWERPLANT	2869.
NACELLES	839.
FUEL SYSTEM	859.
WING	5348.
FUSELAGE	7992.
EMPENNAGE	1361.
LANDING GEAR	2095.
FLIGHT CONTROLS	3597.
HYDRAULICS	342.
ELECTRICAL	1330.
INSTR+AVIONICS	826.
AIR CONDITIONING	1540.
FURNISHINGS	3700.
FLUIDS	349.
FLIGHT CREW	400.
CABIN CREW	300.

STRUCT TECHNOLOGY FACTORS	
*ROTOR	1.00
*TRANSMISSION	0.83
*AIRFRAME	0.78
*ENGINE (HP/LB)	8.50
*ENGINE INSTALLATION	1.50

DESIGN MISSION	
*FIELD ELEVATION (FT)	0.
SOUND SPEED HVR (FPS)	1117.
*STD DAY TEMP (DEG F)	59.
*EMERG HOVER ALT (FT)	2000.
*HOT DAY TEMP (DEG F)	95.
*CT/SIG MAX	0.150
*MAX ACCELERATION (G)	0.25
*DESIGN CRUISE (MPH)	440.
*CRUISE ALTITUDE (FT)	15000.
SOUND SPEED CRSE (FPS)	1058.
*MAX DECELERATION (G)	0.20
*STRUCT LOAD FACTOR	4.5
*FLIGHT CREW	2.
*CABIN CREW	2.
*ATC SPEED LIMIT	YES

* INDICATES INPUT VARIABLE

DESIGN MISSION	SPEED MPH	HEIGHT FT	DIST MI	TIME MIN	FUEL LB
TAKEOFF & LANDING				2.00	146.
ACCEL. & CONV.		1600.	1.6	1.08	94.
AIRPLANE CLIMB	182.,224.	13400.	12.8	3.78	341.
ACCEL. TO CRUISE			14.2	2.27	217.
CRUISE	462.		430.6	55.91	4659.
AIRPLANE DESCENT	462.,301.	12000.	30.8	5.18	62.
APPROACH		3000.	10.0	3.99	53.
TOTAL			500.0	74.21	5570.
RESERVE				20.00	1460.

TILT ROTOR DESIGN PROGRAM 1974

C-8C-110

DESIGN ITERATIONS: 6

OVERALL

GROSS WEIGHT (LB)	102642.
EMPTY WEIGHT (LB)	69985.
FUEL WEIGHT (LB)	10208.
PAYLOAD (LB)	22450.
CRUISE SPEED (MPH)	470.
L/D CRUISE	10.57
*RANGE (STAT MI)	500.
*PASSENGER SEATS	110.
*CARGO (LB)	0.

ROTORS

*DISC LOADING (PSF)	13.00
RADIUS (FT)	35.5
SOLIDITY	0.093
BLADE CHORD (FT)	3.47
TOTAL BLADES	6
*CT/SIG HOVER	0.120
*PROFILE DRAG COEFF	0.010
% DOWNLOAD	10.3
*EFFICIENCY HOVER	0.85
* CONVER	0.83
CRUISE	0.72
HEL MODE WEIGHT (LB)	8754.
AIRPLANE WEIGHT (LB)	7020.
*TIP SPEED HOVER	800.
* CRUISE	570.
*FUSELAGE CLEARANCE (FT)	1.0
*MAX HEL MODE ADV RATIO	0.40

POWERPLANT

INST NORMAL PWR (HP)	23409.
*NUMBER OF ENGINES	2.
*EXCESS FACTOR HEL MODE	1.30
*% RATED EMRG HVR	140.
* CONV + CLIMB	120.
* CRUISE	90.
INST PWR EMRG HVR (HP)	23409.
CONVER (HP)	16508.
CRUISE (HP)	19406.
*SFC (LB/HP HR)	0.400

DRIVE SYSTEM

*EFFICIENCY	0.97
HEL MODE WEIGHT (LB)	5217.
AIRPLANE WEIGHT (LB)	12270.

WING

AREA (SF)	1006.
*LOADING (PSF)	102.0
ASPECT RATIO	7.33
SPAN (FT)	85.9
MEAN CHORD (FT)	11.72
*THICKNESS/CHORD RATIO	0.210
*TAPER RATIO	0.70
SWEEP (DEG)	-5.4
CRUISE LIFT COEFF	0.28
MAX LIFT COEFF CONVER	0.88
*MAX LIFT COEFF CLEAN	1.40
*FLAP AREA/WING AREA	0.25
CLIMB SPD/CONVER SPD	0.86

FUSELAGE

*LENGTH (FT)	110.0
*DIAMETER (FT)	13.0
*DRAG FACTOR	1.00

FLAT PLATE AREAS (SF)

WING PROFILE	6.33
FUSELAGE	8.89
EMPENNAGE	3.80
TOTAL PROFILE	23.00
WING INDUCED	3.89

COMPONENT WEIGHTS (LB)

ROTORS	8754.
DRIVE SYSTEM	12270.
POWERPLANT	4131.
NACELLES	2091.
FUEL SYSTEM	1628.
WING	8068.
FUSELAGE	10879.
EMPENNAGE	2002.
LANDING GEAR	3079.
FLIGHT CONTROLS	6193.
HYDRAULICS	415.
ELECTRICAL	2296.
INSTS+AVIONICS	949.
AIR CONDITIONING	1930.
FURNISHINGS	4900.
FLUIDS	513.
FLIGHT CREW	400.
CABIN CREW	450.

STRUCT TECHNOLOGY FACTORS

*ROTOR	1.00
*TRANSMISSION	0.83
*AIRFRAME	0.78
*ENGINE (HP/LB)	8.50
*ENGINE INSTALLATION	1.50

DESIGN MISSION

*FIELD ELEVATION (FT)	0.
SOUND SPEED HVR (FPS)	1117.
*STD DAY TEMP (DEG F)	59.
*EMERG HOVER ALT (FT)	2000.
*HOT DAY TEMP (DEG F)	95.
*CT/SIG MAX	0.150
*MAX ACCELERATION (G)	0.25
*DESIGN CRUISE (MPH)	440.
*CRUISE ALTITUDE (FT)	15000.
SOUND SPEED CRSE (FPS)	1058.
*MAX DECELERATION (G)	0.20
*STRUCT LOAD FACTOR	4.5
*FLIGHT CREW	2.
*CABIN CREW	3.
*ATC SPEED LIMIT	YES

* INDICATES INPUT VARIABLE

DESIGN MISSION	SPEED MPH	HEIGHT FT	DIST MI	TIME MIN	FUEL LB
TAKEOFF & LANDING				2.00	215.
ACCEL. & CONV.		1600.	1.6	1.35	134.
AIRPLANE CLIMB	188.,230.	13400.	13.1	3.77	501.
ACCEL. TO CRUISE			14.6	2.29	323.
CRUISE	470.		428.4	54.73	6715.
AIRPLANE DESCENT	470.,301.	12000.	32.2	5.40	95.
APPROACH		3000.	10.0	3.99	78.
TOTAL			500.0	73.22	8060.
RESERVE				20.00	2147.

TILT ROTOR DESIGN PROGRAM 1974

C-75-50

DESIGN ITERATIONS: 5

OVERALL

GROSS WEIGHT (LB)	47055.
EMPTY WEIGHT (LB)	31765.
FUEL WEIGHT (LB)	5139.
PAYLOAD (LB)	10150.
CRUISE SPEED (MPH)	457.
L/D CRUISE	9.86
*RANGE (STAT MI)	500.
*PASSENGER SEATS	50.
*CARGO (LB)	0.

ROTORS

*DISC LOADING (PSF)	13.00
RADIUS (FT)	24.0
SOLIDITY	0.093
BLADE CHORD (FT)	2.34
TOTAL BLADES	6
*CT/SIG HOVER	0.120
*PROFILE DRAG COEFF	0.010
% DOWNLOAD	10.0
*EFFICIENCY HOVER	0.83
* CONVER	0.81
CRUISE	0.74
HEL MODE WEIGHT (LB)	4008.
AIRPLANE WEIGHT (LB)	3165.
*TIP SPEED HOVER	800.
* CRUISE	570.
*FUSELAGE CLEARANCE (FT)	1.0
*MAX HEL MODE ADV RATIO	0.40

* INDICATES INPUT VARIABLE

POWERPLANT

INST NORMAL PWR (HP)	10981.
*NUMBER OF ENGINES	2.
*EXCESS FACTOR HEL MODE	1.35
*% RATED EMRG HVR	140.
* CONV + CLIMB	120.
* CRUISE	90.
INST PWR EMRG HVR (HP)	10981.
CONVER (HP)	8042.
CRUISE (HP)	10001.
*SFC (LB/HP HR)	0.420

DRIVE SYSTEM

*EFFICIENCY	0.97
HEL MODE WEIGHT (LB)	3887.
AIRPLANE WEIGHT (LB)	4590.

WING

AREA (SF)	461.
*LOADING (PSF)	102.0
ASPECT RATIO	7.80
SPAN (FT)	60.0
MEAN CHORD (FT)	7.69
*THICKNESS/CHORD RATIO	0.210
*TAPER RATIO	0.72
SWEEP (DEG)	-5.3
CRUISE LIFT COEFF	0.30
MAX LIFT COEFF CONVER	0.88
*MAX LIFT COEFF CLEAN	1.40
*FLAP AREA/WING AREA	0.25
CLIMB SPD/CONVER SPD	0.81

FUSELAGE

*LENGTH (FT)	80.0
*DIAMETER (FT)	10.0
*DRAG FACTOR	1.00

FLAT PLATE AREAS (SF)

WING PROFILE	3.08
FUSELAGE	5.23
EMPENNAGE	1.85
TOTAL PROFILE	12.30
WING INDUCED	1.94

COMPONENT WEIGHTS (LB)

ROTORS	4008.
DRIVE SYSTEM	4990.
POWERPLANT	2353.
NACELLES	567.
FUEL SYSTEM	502.
WING	3370.
FUSELAGE	5766.
EMPENNAGE	941.
LANDING GEAR	1412.
FLIGHT CONTROLS	2062.
HYDRAULICS	281.
ELECTRICAL	761.
INSTR+AVIONICS	703.
AIR CONDITIONING	1150.
FURNISHINGS	2500.
FLUIDS	235.
FLIGHT CREW	400.
CABIN CREW	150.

STRUCT TECHNOLOGY FACTORS

*ROTOR	1.05
*TRANSMISSION	0.85
*AIRFRAME	0.80
*ENGINE (HP/LB)	7.00
*ENGINE INSTALLATION	1.50

DESIGN MISSION

*FIELD ELEVATION (FT)	0.
SOUND SPEED HVR (FPS)	1117.
*STD DAY TEMP (DEG F)	59.
*EMERG HOVER ALT (FT)	2000.
*HOT DAY TEMP (DEG F)	95.
*CT/SIG MAX	0.150
*MAX ACCELERATION (G)	0.25
*DESIGN CRUISE (MPH)	440.
*CRUISE ALTITUDE (FT)	15000.
SOUND SPEED CRSE (FPS)	1058.
*MAX DECELERATION (G)	0.20
*STRUCT LOAD FACTOR	4.5
*FLIGHT CREW	2.
*CABIN CREW	1.
*ATC SPEED LIMIT	YES

DESIGN MISSION	SPEED MPH	HEIGHT FT	DIST MI	TIME MIN	FUEL LB
TAKEOFF & LANDING				2.00	106.
ACCEL. & CONV.		1600.	1.6	1.11	72.
AIRPLANE CLIMB	178.,218.	13400.	12.5	3.79	246.
ACCEL. TO CRUISE			14.4	2.31	160.
CRUISE	457.		432.2	56.92	3417.
AIRPLANE DESCENT	456.,301.	12000.	29.3	4.96	43.
APPROACH		3000.	10.0	3.99	38.
TOTAL			500.0	74.57	4081.
RESERVE				20.00	1058.

TILT ROTOR DESIGN PROGRAM 1974

C-85-50

DESIGN ITERATIONS: 3

OVERALL		POWERPLANT		FUSELAGE		STRUCT TECHNOLOGY FACTORS	
GROSS WEIGHT (LB)	40440.	INST NORMAL PWR (HP)	9210.	*LENGTH (FT)	80.0	*ROTOR	0.95
EMPTY WEIGHT (LB)	26303.	*NUMBER OF ENGINES	2.	*DIAMETER (FT)	10.0	*TRANSMISSION	0.81
FUEL WEIGHT (LB)	3987.	*EXCESS FACTOR HEL MODE	1.35	*DRAG FACTOR	1.00	*AIRFRAME	0.76
PAYLOAD (LB)	10150.	*% RATED EMRG HVR	140.			*ENGINE (HP/LB)	10.00
CRUISE SPEED (MPH)	441.	* CONV + CLIMB	120.	FLAT PLATE AREAS (SF)		*ENGINE INSTALLATION	1.50
L/D CRUISE	9.64	* CRUISE	90.	WING PROFILE	2.68		
*RANGE (STAT MI)	500.	INST PWR EMRG HVR (HP)	9000.	FUSELAGE	5.23	DESIGN MISSION	
*PASSENGER SEATS	50.	CONVER (HP)	6592.	EMPENNAGE	1.61	*FIELD ELEVATION (FT)	0.
*CARGO (LB)	0.	CRUISE (HP)	9210.	TOTAL PROFILE	11.53	SOUND SPEED HVR (FPS)	1117.
		*SFC (LB/HP HR)	0.380	WING INDUCED	1.85	*STD DAY TEMP (DEG F)	59.
ROTORS						*EMERG HOVER ALT (FT)	2000.
*DISC LOADING (PSF)	13.00	DRIVE SYSTEM		COMPONENT WEIGHTS (LB)		*HOT DAY TEMP (DEG F)	95.
RADIUS (FT)	22.3	*EFFICIENCY	0.97	ROTORS	3025.	*CT/SIG MAX	0.150
SOLIDITY	0.093	HEL MODE WEIGHT (LB)	2973.	DRIVE SYSTEM	3976.	*MAX ACCELERATION (G)	0.25
BLADE CHORD (FT)	2.17	AIRPLANE WEIGHT (LB)	3876.	POWERPLANT	1382.	*DESIGN CRUISE (MPH)	440.
TOTAL BLADES	6			NACELLES	153.	*CRUISE ALTITUDE (FT)	15000.
*CT/SIG HOVER	0.120	WING		FUEL SYSTEM	325.	SOUND SPEED CRSE (FPS)	1058.
*PROFILE DRAG COEFF	0.010	AREA (SF)	397.	WING	2914.	*MAX DECELERATION (G)	0.20
% DOWNLOAD	9.8	*LOADING (PSF)	102.0	FUSELAGE	5354.	*STRUCT LOAD FACTOR	4.5
*EFFICIENCY HOVER	0.87	ASPECT RATIO	8.05	EMPENNAGE	768.	*FLIGHT CREW	2.
* CONVER	0.85	SPAN (FT)	56.5	LANDING GEAR	1213.	*CABIN CREW	1.
CRUISE	0.74	MEAN CHORD (FT)	7.02	FLIGHT CONTROLS	1566.	*ATC SPEED LIMIT	YES
HEL MODE WEIGHT (LB)	3025.	*THICKNESS/CHORD RATIO	0.210	HYDRAULICS	269.		
AIRPLANE WEIGHT (LB)	2434.	*TAPER RATIO	0.70	ELECTRICAL	614.		
*TIP SPEED HOVER	800.	SWEEP (DEG)	-5.3	INSTR+AVIONICS	703.		
* CRUISE	573.	CRUISE LIFT COEFF	0.33	AIR CONDITIONING	1150.		
*FUSELAGE CLEARANCE (FT)	1.0	MAX LIFT COEFF CONVER	0.98	FURNISHINGS	2500.		
*MAX HEL MODE ADV RATIO	0.40	*MAX LIFT COEFF CLEAN	1.40	FLUIDS	202.		
		*FLAP AREA/WING AREA	0.25	FLIGHT CREW	400.		
* INDICATES INPUT VARIABLE		CLIMB SPD/CONVER SPD	0.79	CABIN CREW	150.		

DESIGN MISSION	SPEED MPH	HEIGHT FT	DIST MI	TIME MIN	FUEL LB
TAKEOFF & LANDING				2.00	79.
ACCEL. & CONV.		1600.	1.6	1.14	55.
AIRPLANE CLIMB	172.,212.	13400.	11.8	3.66	181.
ACCEL. TO CRUISE			12.4	2.06	107.
CRUISE	441.		436.2	59.37	2717.
AIRPLANE DESCENT	441.,301.	12000.	28.0	4.78	31.
APPROACH		3000.	10.0	3.59	29.
TOTAL			500.0	77.02	3199.
RESERVE				20.00	798.

TILT ROTOR DESIGN PROGRAM 1974

M-80-20

DESIGN ITERATIONS: 3

OVERALL	
GROSS WEIGHT (LB)	19633.
EMPTY WEIGHT (LB)	13616.
FUEL WEIGHT (LB)	2017.
PAYLOAD (LB)	4000.
CRUISE SPEED (MPH)	421.
L/D CRUISE	8.50
*RANGE (STAT MI)	500.
*PASSENGER SEATS	20.
*CARGO (LB)	0.

ROTORS	
*DISC LOADING (PSF)	10.00
RADIUS (FT)	17.7
SOLIDITY	0.053
BLADE CHORD (FT)	1.72
TOTAL BLADES	6
*CT/SIG HOVER	0.120
*PROFILE DRAG COEFF	0.010
% DOWNLOAD	5.0
*EFFICIENCY HOVER	0.85
* CONVER	0.83
CRUISE	0.75
HEL MODE WEIGHT (LB)	1557.
AIRPLANE WEIGHT (LB)	1365.
*TIP SPEED HOVER	700.
* CRUISE	550.
*FUSELAGE CLEARANCE (FT)	1.0
*MAX HEL MODE ADV RATIO	0.40

POWERPLANT	
INST NORMAL PWR (HP)	4491.
*NUMBER OF ENGINES	2.
*EXCESS FACTOR HEL MODE	1.35
*% RATED EMRG HVR	140.
* CONV + CLIMB	120.
* CRUISE	90.
INST PWR EMRG HVR (HP)	3914.
CONVER (HP)	2662.
CRUISE (HP)	4491.
*SFC (LB/HP HR)	0.400

DRIVE SYSTEM	
*EFFICIENCY	0.97
HEL MODE WEIGHT (LB)	1448.
AIRPLANE WEIGHT (LB)	1965.

WING	
AREA (SF)	234.
*LOADING (PSF)	84.0
ASPECT RATIO	9.00
SPAN (FT)	45.9
MEAN CHORD (FT)	5.10
*THICKNESS/CHORD RATIO	0.210
*TAPER RATIO	0.70
SWEEP (DEG)	-5.1
CRUISE LIFT COEFF	0.29
MAX LIFT COEFF CONVER	0.94
*MAX LIFT COEFF CLEAN	1.40
*FLAP AREA/WING AREA	0.25
CLIMB SPD/CONVER SPD	0.78

FUSELAGE	
*LENGTH (FT)	55.0
*DIAMETER (FT)	8.[illegible]
*DRAG FACTOR	1.00

FLAT PLATE AREAS (SF)	
WING PROFILE	1.67
FUSELAGE	3.36
EMPENNAGE	1.00
TOTAL PROFILE	7.29
WING INDUCED	0.80

COMPONENT WEIGHTS (LB)	
ROTORS	1557.
DRIVE SYSTEM	1965.
POWERPLANT	819.
NACELLES	46.
FUEL SYSTEM	101.
WING	1415.
FUSELAGE	2699.
EMPENNAGE	383.
LANDING GEAR	539.
FLIGHT CONTROLS	601.
HYDRAULICS	181.
ELECTRICAL	221.
INSTR+AVIONICS	580.
AIR CONDITIONING	760.
FURNISHINGS	1330.
FLUIDS	58.
FLIGHT CREW	400.
CABIN CREW	0.

STRUCT TECHNOLOGY FACTORS	
*ROTOR	1.00
*TRANSMISSION	0.83
*AIRFRAME	0.78
*ENGINE (HP/LB)	8.50
*ENGINE INSTALLATION	1.55

DESIGN MISSION	
*FIELD ELEVATION (FT)	0.
SOUND SPEED HVR (FPS)	1117.
*STD DAY TEMP (DEG F)	59.
*EMERG HOVER ALT (FT)	2000.
*HOT DAY TEMP (DEG F)	95.
*CT/SIG MAX	0.150
*MAX ACCELERATION (G)	0.25
*DESIGN CRUISE (MPH)	420.
*CRUISE ALTITUDE (FT)	15000.
SOUND SPEED CRSE (FPS)	1058.
*MAX DECELERATION (G)	0.20
*STRUCT LOAD FACTOR	4.5
*FLIGHT CREW	2.
*CABIN CREW	0.
*ATC SPEED LIMIT	YES

* INDICATES INPUT VARIABLE

DESIGN MISSION	SPEED MPH	HEIGHT FT	DIST MI	TIME MIN	FUEL LB
TAKEOFF & LANDING				2.00	37.
ACCEL. & CONV.		1500.	1.6	1.25	28.
AIRPLANE CLIMB	149.,184.	13500.	5.5	3.42	84.
ACCEL. TO CRUISE			11.3	1.58	52.
CRUISE	421.		443.7	63.30	1418.
AIRPLANE DESCENT	421.,301.	12300.	24.3	4.15	13.
APPROACH		3300.	10.0	3.59	15.
TOTAL			500.0	66.09	1647.
RESERVE				23.00	379.

TILT ROTOR DESIGN PROGRAM 1974

*-80-50 DESIGN ITERATIONS: 5

OVERALL		POWERPLANT		FUSELAGE		STRUCT TECHNOLOGY FACTORS	
GROSS WEIGHT (LB)	43006.	INST NORMAL PWR (HP)	8583.	*LENGTH (FT)	80.0	*ROTOR	1.00
EMPTY WEIGHT (LB)	28934.	*NUMBER OF ENGINES	2.	*DIAMETER (FT)	10.0	*TRANSMISSION	0.83
FUEL WEIGHT (LB)	3921.	*EXCESS FACTOR HEL MODE	1.25	*DRAG FACTOR	1.00	*AIRFRAME	0.78
PAYLOAD (LB)	10150.	*% RATED EMRG HVR	140.			*ENGINE (HP/LB)	8.50
CRUISE SPEED (MPH)	427.	* CONV + CLIMB	120.	FLAT PLATE AREAS (SF)		*ENGINE INSTALLATION	1.50
L/D CRUISE	9.51	* CRUISE	90.	WING PROFILE	3.43		
*RANGE (STAT MI)	500.	INST PWR EMRG HVR (HP)	8583.	FUSELAGE	5.27	DESIGN MISSION	
*PASSENGER SEATS	50.	CONVER (HP)	5812.	EMPENNAGE	2.06	*FIELD ELEVATION (FT)	0.
*CARGO (LB)	0.	CRUISE (HP)	8310.	TOTAL PROFILE	13.01	SOUND SPEED HVR (FPS)	1117.
		*SFC (LB/HP HR)	0.406	WING INDUCED	1.87	*STD DAY TEMP (DEG F)	59.
ROTORS						*EMERG HOVER ALT (FT)	2000.
*DISC LOADING (PSF)	10.00	DRIVE SYSTEM		COMPONENT WEIGHTS (LB)		*HOT DAY TEMP (DEG F)	55.
RADIUS (FT)	26.2	*EFFICIENCY	0.97	ROTORS	3572.	*CT/SIG MAX	0.150
SOLIDITY	0.093	HEL MODE WEIGHT (LB)	3493.	DRIVE SYSTEM	4543.	*MAX ACCELERATION (G)	0.25
BLADE CHORD (FT)	2.56	AIRPLANE WEIGHT (LB)	4543.	POWERPLANT	1515.	*DESIGN CRUISE (MPH)	420.
TOTAL BLADES	6			NACELLES	195.	*CRUISE ALTITUDE (FT)	15000.
*CT/SIG HOVER	0.120	WING		FUEL SYSTEM	316.	SOUND SPEED CRSE (FPS)	1058.
*PROFILE DRAG COEFF	0.010	AREA (SF)	512.	WING	3611.	*MAX DECELERATION (G)	0.20
% DOWNLOAD	5.5	*LOADING (PSF)	84.0	FUSELAGE	5546.	*STRUCT LOAD FACTOR	4.5
*EFFICIENCY HOVER	0.85	ASPECT RATIO	8.08	EMPENNAGE	839.	*FLIGHT CREW	2.
* CONVER	0.83	SPAN (FT)	64.3	LANDING GEAR	1290.	*CABIN CREW	1.
CRUISE	0.75	MEAN CHORD (FT)	7.96	FLIGHT CONTROLS	1817.	*ATC SPEED LIMIT	YES
HEL MODE WEIGHT (LB)	3572.	*THICKNESS/CHORD RATIO	0.210	HYDRAULICS	268.		
AIRPLANE WEIGHT (LB)	3125.	*TAPER RATIO	0.70	ELECTRICAL	670.		
*TIP SPEED HOVER	700.	SWEEP (DEG)	-5.3	INSTR+AVIONICS	713.		
* CRUISE	550.	CRUISE LIFT COEFF	0.29	AIR CONDITIONING	1150.		
*FUSELAGE CLEARANCE (FT)	1.0	MAX LIFT COEFF CONVER	0.94	FURNISHINGS	2500.		
*MAX HEL MODE ADV RATIO	0.40	*MAX LIFT COEFF CLEAN	1.40	FLUIDS	215.		
		*FLAP AREA/WING AREA	0.25	FLIGHT CREW	400.		
* INDICATES INPUT VARIABLE		CLIMB SPD/CONVER SPD	0.85	CABIN CREW	150.		

DESIGN MISSION	SPEED MPH	HEIGHT FT	DIST MI	TIME MIN	FUEL LB
TAKEOFF & LANDING				2.00	75.
ACCEL. & CONV.		1500.	1.6	1.19	54.
AIRPLANE CLIMB	162.-155.	13500.	12.3	4.11	155.
ACCEL. TO CRUISE			13.9	2.38	119.
CRUISE	427.		434.0	61.03	2630.
AIRPLANE DESCENT	427.-301.	12000.	28.2	4.65	30.
APPROACH		3000.	10.0	3.59	28.
TOTAL			500.0	79.55	3134.
RESERVE				20.00	787.

TILT ROTOR DESIGN PROGRAM 1974

8-80-80

DESIGN ITERATIONS: 6

OVERALL

GROSS WEIGHT (LB)	70492.
EMPTY WEIGHT (LB)	47924.
FUEL WEIGHT (LB)	6268.
PAYLOAD (LB)	16300.
CRUISE SPEED (MPH)	442.
L/D CRUISE	10.37
*RANGE (STAT MI)	500.
*PASSENGER SEATS	80.
*CARGO (LB)	0.

ROTORS

*DISC LOADING (PSF)	10.00
RADIUS (FT)	33.5
SOLIDITY	0.094
BLADE CHORD (FT)	3.28
TOTAL BLADES	6
*CT/SIG HOVER	0.120
*PROFILE DRAG COEFF	0.010
% DOWNLOAD	9.7
*EFFICIENCY HOVER	0.85
* CONVER	0.93
CRUISE	0.78
HEL MODE WEIGHT (LB)	6205.
AIRPLANE WEIGHT (LB)	5373.
*TIP SPEED HOVER	700.
* CRUISE	550.
*FUSELAGE CLEARANCE (FT)	1.0
*MAX HEL MODE ADV RATIO	0.40

POWERPLANT

INST NORMAL PWR (HP)	14076.
*NUMBER OF ENGINES	2.
*EXCESS FACTOR HEL MODE	1.30
*% RATED EMRG PWR	140.
* CONV + CLIMB	120.
* CRUISE	90.
INST PWR EMRG PWR (HP)	14076.
CONVER (HP)	5912.
CRUISE (HP)	12376.
*SFC (LB/HP HR)	0.400

DRIVE SYSTEM

*EFFICIENCY	0.97
HEL MODE WEIGHT (LB)	6525.
AIRPLANE WEIGHT (LB)	6255.

WING

AREA (SF)	839.
*LOADING (PSF)	84.0
ASPECT RATIO	7.72
SPAN (FT)	80.5
MEAN CHORD (FT)	10.43
*THICKNESS/CHORD RATIO	0.210
*TAPER RATIO	0.70
SWEEP (DEG)	-5.3
CRUISE LIFT COEFF	0.27
MAX LIFT COEFF CONVER	0.94
*MAX LIFT COEFF CLEAN	1.40
*FLAP AREA/WING AREA	0.25
CLIMB SPD/CONVER SPD	0.88

FUSELAGE

*LENGTH (FT)	95.0
*DIAMETER (FT)	11.5
*DRAG FACTOR	1.00

FLAT PLATE AREAS (SF)

WING PROFILE	5.40
FUSELAGE	6.99
EMPENNAGE	3.24
TOTAL PROFILE	18.92
WING INDUCED	2.78

COMPONENT WEIGHTS (LB)

ROTORS	6205.
DRIVE SYSTEM	8255.
POWERPLANT	2567.
NACELLES	678.
FUEL SYSTEM	766.
WING	6216.
FUSELAGE	8004.
EMPENNAGE	1375.
LANDING GEAR	2115.
FLIGHT CONTROLS	3646.
HYDRAULICS	344.
ELECTRICAL	1398.
INSTR+AVIONICS	826.
AIR CONDITIONING	1540.
FURNISHINGS	3700.
FLUIDS	352.
FLIGHT CREW	400.
CABIN CREW	300.

STRUCT TECHNOLOGY FACTORS

*ROTOR	1.00
*TRANSMISSION	0.83
*AIRFRAME	0.78
*ENGINE (HP/LB)	8.50
*ENGINE INSTALLATION	1.55

DESIGN MISSION

*FIELD ELEVATION (FT)	0.
SOUND SPEED HVR (FPS)	1117.
*STD DAY TEMP (DEG F)	59.
*EMERG HOVER ALT (FT)	2000.
*HOT DAY TEMP (DEG F)	95.
*CT/SIG MAX	0.150
*MAX ACCELERATION (G)	0.25
*DESIGN CRUISE (MPH)	420.
*CRUISE ALTITUDE (FT)	15000.
SOUND SPEED CRSE (FPS)	1058.
*MAX DECELERATION (G)	0.20
*STRUCT LOAD FACTOR	4.5
*FLIGHT CREW	2.
*CABIN CREW	2.
*ATC SPEED LIMIT	YES

* INDICATES INPUT VARIABLE

DESIGN MISSION	SPEED MPH	HEIGHT FT	DIST MI	TIME MIN	FUEL LB
TAKEOFF & LANDING				2.00	129.
ACCEL. & CONV.		1500.	1.6	1.11	85.
AIRPLANE CLIMB	168.,207.	13500.	12.8	4.10	320.
ACCEL. TO CRUISE			14.5	2.42	200.
CRUISE	442.		430.7	58.52	4144.
AIRPLANE DESCENT	442.,301.	12500.	30.4	5.18	52.
APPROACH		3000.	10.0	3.99	47.
TOTAL			500.0	77.33	4577.
RESERVE				20.00	1291.

TILT ROTOR DESIGN PROGRAM 1974

B-80-110

DESIGN ITERATIONS: 6

OVERALL	
GROSS WEIGHT (LB)	103223.
EMPTY WEIGHT (LB)	71750.
FUEL WEIGHT (LB)	9023.
PAYLOAD (LB)	22450.
CRUISE SPEED (MPH)	452.
L/D CRUISE	10.70
*RANGE (STAT MI)	500.
*PASSENGER SEATS	110.
*CARGO (LB)	0.

ROTORS	
*DISC LOADING (PSF)	10.00
RADIUS (FT)	43.5
SOLIDITY	0.094
BLADE CHORD (FT)	3.97
TOTAL BLADES	6
*CT/SIG HOVER	0.120
*PROFILE DRAG COEFF	0.010
% DOWNLOAD	9.9
*EFFICIENCY HOVER	0.85
* CONVER	0.83
CRUISE	0.77
HEL MODE WEIGHT (LB)	9405.
AIRPLANE WEIGHT (LB)	9153.
*TIP SPEED HOVER	700.
* CRUISE	550.
*FUSELAGE CLEARANCE (FT)	1.0
*MAX HEL MODE ADV RATIO	0.40

POWERPLANT	
INST NORMAL PWR (HP)	20620.
*NUMBER OF ENGINES	2.
*EXCESS FACTOR HEL MODE	1.30
*% RATED EMRG HVR	140.
* CONV + CLIMB	120.
* CRUISE	90.
INST PWR EMRG HVR (HP)	20620.
CONVER (HP)	14520.
CRUISE (HP)	17084.
*SFC (LB/HP HR)	0.400

DRIVE SYSTEM	
*EFFICIENCY	0.97
HEL MODE WEIGHT (LB)	10315.
AIRPLANE WEIGHT (LB)	13084.

WING	
AREA (SF)	1229.
*LOADING (PSF)	84.0
ASPECT RATIO	7.51
SPAN (FT)	96.1
MEAN CHORD (FT)	12.79
*THICKNESS/CHORD RATIO	0.210
*TAPER RATIO	0.70
SWEEP (DEG)	-5.4
CRUISE LIFT COEFF	0.26
MAX LIFT COEFF CONVER	0.94
*MAX LIFT COEFF CLEAN	1.40
*FLAP AREA/WING AREA	0.25
CLIMB SPD/CONVER SPD	0.90

FUSELAGE	
*LENGTH (FT)	110.0
*DIAMETER (FT)	13.0
*DRAG FACTOR	1.00

FLAT PLATE AREAS (SF)	
WING PROFILE	7.69
FUSELAGE	8.94
EMPENNAGE	4.61
TOTAL PROFILE	25.69
WING INDUCED	3.84

COMPONENT WEIGHTS (LB)	
ROTORS	9405.
DRIVE SYSTEM	13084.
POWERPLANT	3760.
NACELLES	1674.
FUEL SYSTEM	1318.
WING	9359.
FUSELAGE	10888.
EMPENNAGE	2013.
LANDING GEAR	3097.
FLIGHT CONTROLS	6243.
HYDRAULICS	416.
ELECTRICAL	2314.
INSTR+AVIONICS	949.
AIR CONDITIONING	1930.
FURNISHINGS	4900.
FLUIDS	516.
FLIGHT CREW	400.
CABIN CREW	450.

STRUCT TECHNOLOGY FACTORS	
*ROTOR	1.00
*TRANSMISSION	0.83
*AIRFRAME	0.78
*ENGINE (HP/LB)	8.50
*ENGINE INSTALLATION	1.55

DESIGN MISSION	
*FIELD ELEVATION (FT)	0.
SOUND SPEED HVR (FPS)	1117.
*STD DAY TEMP (DEG F)	59.
*EMERG HOVER ALT (FT)	2000.
*HOT DAY TEMP (DEG F)	95.
*CT/SIG MAX	0.150
*MAX ACCELERATION (G)	0.25
*DESIGN CRUISE (MPH)	420.
*CRUISE ALTITUDE (FT)	15000.
SOUND SPEED CRSE (FPS)	1058.
*MAX DECELERATION (G)	0.20
*STRUCT LOAD FACTOR	4.5
*FLIGHT CREW	2.
*CABIN CREW	3.
*ATC SPEED LIMIT	YES

* INDICATES INPUT VARIABLE

DESIGN MISSION	SPEED MPH	HEIGHT FT	DIST MI	TIME MIN	FUEL LB
TAKEOFF & LANDING				2.00	189.
ACCEL. & CONV.		1500.	1.6	1.08	122.
AIRPLANE CLIMB	173.,212.	13500.	13.1	4.05	468.
ACCEL. TO CRUISE			15.8	2.56	311.
CRUISE	452.		427.6	56.74	5893.
AIRPLANE DESCENT	452.,301.	12000.	31.9	5.40	79.
APPROACH		3000.	10.0	3.99	68.
TOTAL			500.0	75.66	7131.
RESERVE				20.00	1891.

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TILT ROTOR DESIGN PROGRAM 1974

B-75-50

DESIGN ITERATIONS: 5

OVERALL

GROSS WEIGHT (LB)	46982.
EMPTY WEIGHT (LB)	32281.
FUEL WEIGHT (LB)	4551.
PAYLOAD (LB)	10150.
CRUISE SPEED (MPH)	433.
L/D CRUISE	5.89
*RANGE (STAT MI)	500.
*PASSENGER SEATS	50.
*CARGO (LB)	0.

ROTORS

*DISC LOADING (PSF)	10.00
RADIUS (FT)	27.3
SOLIDITY	C.093
BLADE CHORD (FT)	2.68
TOTAL BLADES	6
*CT/SIG HOVER	0.120
*PROFILE DRAG COEFF	0.010
% DOWNLOAD	9.6
*EFFICIENCY HOVER	0.83
* CONVER	0.81
CRUISE	C.78
HEL MODE WEIGHT (LB)	4168.
AIRPLANE WEIGHT (LB)	3650.
*TIP SPEED HOVER	730.
* CRUISE	550.
*FUSELAGE CLEARANCE (FT)	1.0
*MAX HEL MODE ADV RATIO	C.40

* INDICATES INPUT VARIABLE

POWERPLANT

INST NORMAL PWR (HP)	5605.
*NUMBER OF ENGINES	2.
*EXCESS FACTOR HEL MODE	1.25
*% RATED EMRG PWR	140.
* CONV + CLIMB	120.
* CRUISE	93.
INST PWR EMRG PWR (HP)	5605.
CONVER (HP)	6503.
CRUISE (HP)	6742.
*SFC (LB/HP HR)	C.420

DRIVE SYSTEM

*EFFICIENCY	C.97
HEL MODE WEIGHT (LB)	4055.
AIRPLANE WEIGHT (LB)	5281.

WING

AREA (SF)	559.
*LOADING (PSF)	84.0
ASPECT RATIO	7.95
SPAN (FT)	66.7
MEAN CHORD (FT)	8.39
*THICKNESS/CHORD RATIO	C.210
*TAPER RATIO	3.70
SWEEP (DEG)	-5.3
CRUISE LIFT COEFF	0.27
MAX LIFT COEFF CONVER	0.94
*MAX LIFT COEFF CLEAN	1.40
*FLAP AREA/WING AREA	C.25
CLIMB SPD/CONVER SPD	C.86

FUSELAGE

*LENGTH (FT)	80.0
*DIAMETER (FT)	10.0
*DRAG FACTOR	1.00

FLAT PLATE AREAS (SF)

WING PROFILE	3.72
FUSELAGE	5.27
EMPENNAGE	2.23
TOTAL PROFILE	13.57
WING INDUCED	1.86

COMPONENT WEIGHTS (LB)

ROTORS	4164.
DRIVE SYSTEM	5281.
POWERPLANT	2127.
NACELLES	446.
FUEL SYSTEM	408.
WING	3891.
FUSELAGE	5764.
EMPENNAGE	940.
LANDING GEAR	1410.
FLIGHT CONTROLS	2058.
HYDRAULICS	280.
ELECTRICAL	759.
INSTR+AVIONICS	703.
AIR CONDITIONING	1150.
FURNISHINGS	2500.
FLUIDS	235.
FLIGHT CREW	400.
CABIN CREW	150.

STRUCT TECHNOLOGY FACTORS

*ROTOR	1.05
*TRANSMISSION	0.85
*AIRFRAME	0.80
*ENGINE (HP/LB)	7.00
*ENGINE INSTALLATION	1.55

DESIGN MISSION

*FIELD ELEVATION (FT)	0.
SOUND SPEED HVR (FPS)	1117.
*STD DAY TEMP (DEG F)	59.
*EMERG HOVER ALT (FT)	2000.
*HOT DAY TEMP (DEG F)	95.
*CT/SIG MAX	0.150
*MAX ACCELERATION (G)	0.25
*DESIGN CRUISE (MPH)	420.
*CRUISE ALTITUDE (FT)	15000.
SOUND SPEED CRSE (FPS)	1058.
*MAX DECELERATION (G)	0.20
*STRUCT LOAD FACTOR	4.5
*FLIGHT CREW	2.
*CABIN CREW	1.
*ATC SPEED LIMIT	YES

DESIGN MISSION	SPEED MPH	HEIGHT FT	DIST MI	TIME MIN	FUEL LB
TAKEOFF & LANDING				2.00	93.
ACCEL. & CONV.		1500.	1.6	1.14	61.
AIRPLANE CLIMB	164.,232.	13500.	12.5	4.11	229.
ACCEL. TO CRUISE			14.2	2.40	142.
CRUISE	433.		433.0	60.02	3033.
AIRPLANE DESCENT	433.,301.	12000.	28.8	4.94	35.
APPROACH		3000.	11.0	3.39	33.
TOTAL			500.0	78.60	3626.
RESERVE				20.00	925.

TILT ROTOR DESIGN PROGRAM 1974

R-85-50

DESIGN ITERATIONS: 4

OVERALL	
GROSS WEIGHT (LB)	40632.
EMPTY WEIGHT (LB)	26935.
FUEL WEIGHT (LB)	3518.
PAYLOAD (LB)	10150.
CRUISE SPEED (MPH)	421.
L/D CRUISE	9.82
*RANGE (STAT MI)	500.
*PASSENGER SEATS	50.
*CARGO (LB)	0.
ROTORS	
*DISC LOADING (PSF)	10.00
RADIUS (FT)	25.4
SOLIDITY	0.093
BLADE CHORD (FT)	2.49
TOTAL BLADES	6
*CT/SIG HOVER	0.120
*PROFILE DRAG COEFF	0.010
% DOWNLOAD	9.4
*EFFICIENCY HOVER	0.87
* CONVER	0.85
CRUISE	0.79
HEL MODE WEIGHT (LB)	3162.
AIRPLANE WEIGHT (LB)	2784.
*TIP SPEED HOVER	700.
* CRUISE	550.
*FUSELAGE CLEARANCE (FT)	1.0
*MAX HEL MODE ADV RATIO	0.40

POWERPLANT	
INST NORMAL PWR (HP)	6048.
*NUMBER OF ENGINES	2.
*EXCESS FACTOR HEL MODE	1.25
*% RATED EMRG PWR	140.
* CONV + CLIMB	120.
* CRUISE	90.
INST PWR EMRG PWR (HP)	7916.
CONVER (HP)	5360.
CRUISE (HP)	8048.
*SFC (LB/HP HR)	0.380
DRIVE SYSTEM	
*EFFICIENCY	0.97
HEL MODE WEIGHT (LB)	3121.
AIRPLANE WEIGHT (LB)	4111.
WING	
AREA (SF)	483.
*LOADING (PSF)	84.0
ASPECT RATIO	8.17
SPAN (FT)	62.8
MEAN CHORD (FT)	7.69
*THICKNESS/CHORD RATIO	0.210
*TAPER RATIO	0.70
SWEEP (DEG)	-5.2
CRUISE LIFT COEFF	0.29
MAX LIFT COEFF CONVER	0.94
*MAX LIFT COEFF CLEAN	1.40
*FLAP AREA/WING AREA	0.25
CLIMB SPD/CONVER SPD	0.84

FUSELAGE	
*LENGTH (FT)	80.0
*DIAMETER (FT)	10.0
*DRAG FACTOR	1.00
FLAT PLATE AREAS (SF)	
WING PROFILE	3.25
FUSELAGE	5.27
EMPENNAGE	1.95
TOTAL PROFILE	12.67
WING INDUCED	1.82
COMPONENT WEIGHTS (LB)	
ROTORS	3162.
DRIVE SYSTEM	4111.
POWERPLANT	1247.
NACELLES	120.
FUEL SYSTEM	262.
WING	3379.
FUSELAGE	5357.
EMPENNAGE	771.
LANDING GEAR	1218.
FLIGHT CONTROLS	1675.
HYDRAULICS	261.
ELECTRICAL	617.
INSTR+AVIONICS	703.
AIR CONDITIONING	1150.
FURNISHINGS	2500.
FLUIDS	293.
FLIGHT CREW	400.
CABIN CREW	150.

STRUCT TECHNOLOGY FACTORS	
*ROTOR	0.95
*TRANSMISSION	0.81
*AIRFRAME	0.76
*ENGINE (HP/LB)	10.00
*ENGINE INSTALLATION	1.55
DESIGN MISSION	
*FIELD ELEVATION (FT)	0.
SOUND SPEED HVR (FPS)	1117.
*STD DAY TEMP (DEG F)	59.
*EMERG HOVER ALT (FT)	2000.
*HOT DAY TEMP (DEG F)	95.
*CT/SIG MAX	0.150
*MAX ACCELERATION (G)	0.25
*DESIGN CRUISE (MPH)	420.
*CRUISE ALTITUDE (FT)	15000.
SOUND SPEED CRSE (FPS)	1058.
*MAX DECELERATION (G)	0.20
*STRUCT LOAD FACTOR	4.5
*FLIGHT CREW	2.
*CABIN CREW	1.
*ATC SPEED LIMIT	YES

* INDICATES INPUT VARIABLE

DESIGN MISSION	SPEED MPH	HEIGHT FT	DIST MI	TIME MIN	FUEL LB
TAKEOFF & LANDING				2.00	69.
ACCEL. & CONV.		1500.	1.6	1.17	47.
AIRPLANE CLIMB	160.,197.	13500.	11.9	4.32	169.
ACCEL. TO CRUISE			12.6	2.20	98.
CRUISE	421.		436.2	62.22	2391.
AIRPLANE DESCENT	421.,301.	12000.	27.7	4.75	26.
APPROACH		3000.	10.0	3.99	25.
TOTAL			500.0	80.38	2825.
RESERVE				20.00	692.

TILT ROTOR DESIGN PROGRAM 1974

0-8C-26

DESIGN ITERATIONS: 2

OVERALL		POWERPLANT		FUSELAGE		STRUCT TECHNOLOGY FACTORS	
GROSS WEIGHT (LB)	20181.	INST NORMAL PWR (HP)	4305.	*LENGTH (FT)	55.0	*ROTOR	1.00
EMPTY WEIGHT (LB)	14246.	*NUMBER OF ENGINES	2.	*DIAMETER (FT)	8.5	*TRANSMISSION	0.83
FUEL WEIGHT (LB)	1934.	*EXCESS FACTOR HEL MODE	1.40	*DRAG FACTOR	1.00	*AIRFRAME	0.78
PAYLOAD (LB)	4000.	*% RATED EMRG HVR	140.			*ENGINE (HP/LB)	8.50
CRUISE SPEED (MPH)	411.	* CONV + CLIMB	120.	FLAT PLATE AREAS (SF)		*ENGINE INSTALLATION	1.72
L/D CRUISE	8.52	* CRUISE	90.	WING PROFILE	1.98		
*RANGE (STAT MI)	500.	INST PWR EMRG HVR (HP)	3658.	FUSELAGE	3.37	DESIGN MISSION	
*PASSENGER SEATS	20.	CONVER (HP)	2803.	EMPENNAGE	1.19	*FIELD ELEVATION (FT)	0.
*CARGO (LB)	0.	CRUISE (HP)	4335.	TOTAL PROFILE	7.90	SOUND SPEED HVR (FPS)	1117.
		*SFC (LB/HP HR)	0.410	WING INDUCED	0.60	*STD DAY TEMP (DEG F)	59.
ROTORS						*EMERG HOVER ALT (FT)	2000.
*DISC LOADING (PSF)	8.50	DRIVE SYSTEM		COMPONENT WEIGHTS (LB)		*HOT DAY TEMP (DEG F)	95.
RADIUS (FT)	19.4	*EFFICIENCY	0.97	ROTORS	1718.	*CT/SIG MAX	0.150
SOLIDITY	0.058	HEL MODE WEIGHT (LB)	1672.	DRIVE SYSTEM	2147.	*MAX ACCELERATION (G)	0.25
BLADE CHORD (FT)	1.59	AIRPLANE WEIGHT (LB)	2147.	POWERPLANT	371.	*DESIGN CRUISE (MPH)	410.
TOTAL BLADES	6			NACELLES	53.	*CRUISE ALTITUDE (FT)	15000.
*CT/SIG HOVER	0.120	WING		FUEL SYSTEM	94.	SOUND SPEED CRSE (FPS)	1058.
*PROFILE DRAG COEFF	0.010	AREA (SF)	280.	WING	1578.	*MAX DECELERATION (G)	0.20
% DOWNLOAD	5.1	*LOADING (PSF)	72.0	FUSELAGE	2710.	*STRUCT LOAD FACTOR	4.5
*EFFICIENCY HOVER	0.85	ASPECT RATIO	8.70	EMPENNAGE	393.	*FLIGHT CREW	2.
* CONVER	0.83	SPAN (FT)	49.4	LANDING GEAR	605.	*CABIN CREW	0.
CRUISE	0.80	MEAN CHORD (FT)	5.68	FLIGHT CONTROLS	625.	*ATC SPEED LIMIT	YES
HEL MODE WEIGHT (LB)	1718.	*THICKNESS/CHORD RATIO	0.210	HYDRAULICS	184.		
AIRPLANE WEIGHT (LB)	1634.	*TAPER RATIO	0.70	ELECTRICAL	229.		
*TIP SPEED HOVER	633.	SWEEP (DEG)	-5.2	INSTR+AVIONICS	580.		
* CRUISE	540.	CRUISE LIFT COEFF	0.26	AIR CONDITIONING	763.		
*FUSELAGE CLEARANCE (FT)	1.0	MAX LIFT COEFF CONVER	1.60	FURNISHINGS	1360.		
*MAX HEL MODE ADV RATIO	0.40	*MAX LIFT COEFF CLEAN	1.40	FLUIDS	101.		
		*FLAP AREA/WING AREA	0.25	FLIGHT CREW	410.		
* INDICATES INPUT VARIABLE		CLIMB SPD/CONVER SPD	0.83	CABIN CREW	0.		

DESIGN MISSION	SPEED MPH	HEIGHT FT	DIST MI	TIME MIN	FUEL LB
TAKEOFF & LANDING				2.00	35.
ACCEL. & CONV.		1500.	1.3	1.12	25.
AIRPLANE CLIMB	143..176.	13500.	5.2	2.47	81.
ACCEL. TO CRUISE			10.9	1.96	48.
CRUISE	411.		453.0	65.65	1368.
AIRPLANE DESCENT	410..301.	2000.	23.6	4.11	12.
APPROACH		3000.	5.9	3.55	14.
TOTAL			500.0	81.67	1583.
RESERVE				20.00	351.

TILT ROTOR DESIGN PROGRAM 1974

Q-EC-50 — DESIGN ITERATIONS: 5

OVERALL		POWERPLANT		FUSELAGE		STRUCT TECHNOLOGY FACTORS	
GROSS WEIGHT (LB)	44115.	INST NORMAL PWR (HP)	6096.	*LENGTH (FT)	80.0	*ROTOR	1.00
EMPTY WEIGHT (LB)	30219.	*NUMBER OF ENGINES	2.	*DIAMETER (FT)	10.0	*TRANSMISSION	0.83
FUEL WEIGHT (LB)	3746.	*EXCESS FACTOR HEL MODE	1.40	*DRAG FACTOR	1.00	*AIRFRAME	0.78
PAYLOAD (LB)	10150.	*% RATED EMRG HVR	140.			*ENGINE (HP/LB)	8.50
CRUISE SPEED (MPH)	411.	* CONV + CLIMB	120.	FLAT PLATE AREAS (SF)		*ENGINE INSTALLATION	1.50
L/D CRUISE	9.93	* CRUISE	50.	WING PROFILE	4.06		
*RANGE (STAT MI)	500.	INST PWR EMRG HVR (HP)	8056.	FUSELAGE	5.29	DESIGN MISSION	
*PASSENGER SEATS	50.	CONVER (HP)	6136.	EMPENNAGE	2.43	*FIELD ELEVATION (FT)	0.
*CARGO (LB)	0.	CRUISE (HP)	8011.	TOTAL PROFILE	14.25	SOUND SPEED HVR (FPS)	1117.
		*SFC (LB/HP HR)	0.400	WING INDUCED	1.89	*STD DAY TEMP (DEG F)	59.
ROTORS						*EMERG HOVER ALT (FT)	2000.
*DISC LOADING (PSF)	8.50	DRIVE SYSTEM		COMPONENT WEIGHTS (LB)		*HOT DAY TEMP (DEG F)	95.
RADIUS (FT)	28.7	*EFFICIENCY	0.97	ROTORS	4035.	*CT/SIG MAX	0.150
SOLIDITY	0.098	HEL MODE WEIGHT (LB)	4275.	DRIVE SYSTEM	4893.	*MAX ACCELERATION (G)	0.25
BLADE CHORD (FT)	2.95	AIRPLANE WEIGHT (LB)	4853.	POWERPLANT	1429.	*DESIGN CRUISE (MPH)	410.
TOTAL BLADES	6			NACELLES	170.	*CRUISE ALTITUDE (FT)	15000.
*CT/SIG HOVER	0.120	WING		FUEL SYSTEM	292.	SOUND SPEED CRSE (FPS)	1058.
*PROFILE DRAG COEFF	0.010	AREA (SF)	613.	WING	4947.	*MAX DECELERATION (G)	0.20
% DOWNLOAD	5.6	*LOADING (PSF)	72.0	FUSELAGE	5567.	*STRUCT LOAD FACTOR	4.5
*EFFICIENCY HOVER	0.85	ASPECT RATIO	7.88	EMPENNAGE	860.	*FLIGHT CREW	2.
* CONVER	0.83	SPAN (FT)	69.5	LANDING GEAR	1324.	*CABIN CREW	1.
CRUISE	0.86	MEAN CHORD (FT)	8.82	FLIGHT CONTROLS	1983.	*ATC SPEED LIMIT	YES
HEL MODE WEIGHT (LB)	4035.	*THICKNESS/CHORD RATIO	0.210	HYDRAULICS	272.		
AIRPLANE WEIGHT (LB)	3656.	*TAPER RATIO	0.70	ELECTRICAL	894.		
*TIP SPEED HOVER	630.	SWEEP (DEG)	-5.3	INSTR+AVIONICS	703.		
* CRUISE	540.	CRUISE LIFT COEFF	0.26	AIR CONDITIONING	1150.		
*FUSELAGE CLEARANCE (FT)	1.0	MAX LIFT COEFF CONVER	1.00	FURNISHINGS	2500.		
*MAX HEL MODE ADV RATIO	0.40	*MAX LIFT COEFF CLEAN	1.40	FLUIDS	221.		
		*FLAP AREA/WING AREA	0.25	FLIGHT CREW	400.		
* INDICATES INPUT VARIABLE		CLIMB SPD/CONVER SPD	0.90	CABIN CREW	150.		

DESIGN MISSION	SPEED MPH	HEIGHT FT	DIST MI	TIME MIN	FUEL LB
TAKEOFF & LANDING				2.00	74.
ACCEL. & CONV.		1500.	1.3	1.01	48.
AIRPLANE CLIMB	154.,185.	13500.	12.1	4.24	187.
ACCEL. TO CRUISE			12.2	2.19	102.
CRUISE	411.		436.9	63.65	2535.
AIRPLANE DESCENT	411.,301.	12000.	27.6	4.81	26.
APPROACH		3000.	5.9	3.55	27.
TOTAL			500.0	82.06	3003.
RESERVE				20.00	742.

TILT ROTOR DESIGN PROGRAM 1974

Q-80-80 DESIGN ITERATIONS: 6

OVERALL		POWERPLANT		FUSELAGE		STRUCT TECHNOLOGY FACTORS	
GROSS WEIGHT (LB)	73665.	INST NORMAL PWR (HP)	13525.	*LENGTH (FT)	95.0	*ROTOR	1.00
EMPTY WEIGHT (LB)	51263.	*NUMBER OF ENGINES	2.	*DIAMETER (FT)	11.5	*TRANSMISSION	0.83
FUEL WEIGHT (LB)	6102.	*EXCESS FACTOR HEL MODE	1.45	*DRAG FACTOR	1.00	*AIRFRAME	0.78
PAYLOAD (LB)	16300.	*% RATED EMRG HVR	140.			*ENGINE (HP/LB)	8.50
CRUISE SPEED (MPH)	425.	* CONV + CLIMB	120.	FLAT PLATE AREAS (SF)		*ENGINE INSTALLATION	1.72
L/D CRUISE	10.38	* CRUISE	90.	WING PROF	6.51		
*RANGE (STAT MI)	500.	INST PWR EMRG HVR (HP)	13525.	FUSELAGE	7.02	DESIGN MISSION	
*PASSENGER SEATS	80.	CONVER (HP)	10618.	EMPENNAGE	3.93	*FIELD ELEVATION (FT)	0.
*CARGO (LB)	0.	CRUISE (HP)	12118.	TOTAL PROFILE	21.09	SOUND SPEED HVR (FPS)	1117.
		*SFC (LB/HP HR)	0.400	WING INDUCED	2.84	*STD DAY TEMP (DEG F)	59.
ROTORS						*EMERG HOVER ALT (FT)	2000.
*DISC LOADING (PSF)	8.50	DRIVE SYSTEM		COMPONENT WEIGHTS (LB)		*HOT DAY TEMP (DEG F)	95.
RADIUS (FT)	37.1	*EFFICIENCY	0.97	ROTORS	7142.	*CT/SIG MAX	0.150
SOLIDITY	0.098	HEL MODE WEIGHT (LB)	8146.	DRIVE SYSTEM	5085.	*MAX ACCELERATION (G)	0.25
BLADE CHORD (FT)	3.62	AIRPLANE WEIGHT (LB)	9389.	POWERPLANT	2737.	*DESIGN CRUISE (MPH)	410.
TOTAL BLADES	6			NACELLES	790.	*CRUISE ALTITUDE (FT)	15000.
*CT/SIG HOVER	0.120	WING		FUEL SYSTEM	674.	SOUND SPEED CRSE (FPS)	1058.
*PROFILE DRAG COEFF	0.010	AREA (SF)	1023.	WING	6556.	*MAX DECELERATION (G)	0.20
% DOWNLOAD	5.8	*LOADING (PSF)	72.0	FUSELAGE	8057.	*STRUCT LOAD FACTOR	4.5
*EFFICIENCY HOVER	0.85	ASPECT RATIO	7.53	EMPENNAGE	1437.	*FLIGHT CREW	2.
* CONVER	0.83	SPAN (FT)	87.8	LANDING GEAR	2210.	*CABIN CREW	2.
CRUISE	0.79	MEAN CHORD (FT)	11.66	FLIGHT CONTROLS	3879.	*ATC SPEED LIMIT	YES
HEL MODE WEIGHT (LB)	7142.	*THICKNESS/CHORD RATIO	0.210	HYDRAULICS	351.		
AIRPLANE WEIGHT (LB)	6404.	*TAPER RATIO	0.70	ELECTRICAL	1435.		
*TIP SPEED HOVER	630.	SWEEP (DEG)	-5.4	INSTR+AVIONICS	826.		
* CRUISE	540.	CRUISE LIFT COEFF	0.24	AIR CONDITIONING	1540.		
*FUSELAGE CLEARNCE (FT)	1.0	MAX LIFT COEFF CONVER	1.00	FURNISHINGS	3730.		
*MAX HEL MODE ADV RATIO	0.40	*MAX LIFT COEFF CLEAN	1.40	FLUIDS	368.		
		*FLAP AREA/WING AREA	0.25	FLIGHT CREW	400.		
* INDICATES INPUT VARIABLE		CLIMB SPD/CONVER SPD	0.53	CABIN CREW	300.		

DESIGN MISSION	SPEED MPH	HEIGHT FT	DIST MI	TIME MIN	FUEL LB
TAKEOFF & LANDING				2.00	124.
ACCEL. & CONV.		1500.	1.3	1.00	81.
AIRPLANE CLIMB	160.,157.	13500.	12.6	4.23	312.
ACCEL. TO CRUISE			13.5	2.34	184.
CRUISE	425.		432.8	61.12	4069.
AIRPLANE DESCENT	425.,301.	12110.	29.9	5.15	47.
APPROACH		3000.	9.9	3.95	44.
TOTAL			500.0	79.79	4861.
RESERVE				20.00	1240.

TILT ROTOR DESIGN PROGRAM 1974

C-80-110

DESIGN ITERATIONS: 6

OVERALL		POWERPLANT		FUSELAGE		STRUCT TECHNOLOGY FACTORS	
GROSS WEIGHT (LB)	108383.	INST NORMAL PWR (HP)	19507.	*LENGTH (FT)	110.0	*ROTOR	1.00
EMPTY WEIGHT (LB)	77147.	*NUMBER OF ENGINES	2.	*DIAMETER (FT)	13.0	*TRANSMISSION	0.83
FUEL WEIGHT (LB)	8786.	*EXCESS FACTOR HEL MODE	1.40	*DRAG FACTOR	1.00	*AIRFRAME	0.78
PAYLOAD (LB)	22450.	*% RATED EMRG HVR	140.			*ENGINE (HP/LB)	8.50
CRUISE SPEED (MPH)	438.	* CONV + CLIMB	120.	FLAT PLATE AREAS (SF)		*ENGINE INSTALLATION	1.72
L/D CRUISE	10.75	* CRUISE	90.	WING PROFILE	9.30		
*RANGE (STAT MI)	500.	INST PWR EMRG HVR (HP)	15507.	FUSELAGE	8.97	DESIGN MISSION	
*PASSENGER SEATS	110.	CONVER (HP)	15088.	EMPENNAGE	5.58	*FIELD ELEVATION (FT)	0.
*CARGO (LB)	0.	CRUISE (HP)	16321.	TOTAL PROFILE	28.65	SOUND SPEED HVR (FPS)	1117.
		*SFC (LB/HP HR)	0.400	WING INDUCED	4.01	*STD DAY TEMP (DEG F)	59.
ROTORS						*EMERG HOVER ALT (FT)	2000.
*DISC LOADING (PSF)	8.50	DRIVE SYSTEM		COMPONENT WEIGHTS (LB)		*HOT DAY TEMP (DEG F)	95.
RADIUS (FT)	45.0	*EFFICIENCY	0.97	ROTORS	10755.	*CT/SIG MAX	0.150
SOLIDITY	0.0[illegible]	HEL MODE WEIGHT (LB)	12592.	DRIVE SYSTEM	14482.	*MAX ACCELERATION (G)	0.25
BLADE CHORD (FT)	4.64	AIRPLANE WEIGHT (LB)	14482.	POWERPLANT	4028.	*DESIGN CRUISE (MPH)	410.
TOTAL BLADES	6			NACELLES	1970.	*CRUISE ALTITUDE (FT)	15000.
*CT/SIG HOVER	0.120	WING		FUEL SYSTEM	1259.	SOUND SPEED CRSE (FPS)	1058.
*PROFILE DRAG COEFF	0.310	AREA (SF)	1505.	WING	10549.	*MAX DECELERATION (G)	0.20
% DOWNLOAD	10.0	*LOADING (PSF)	72.0	FUSELAGE	10968.	*STRUCT LOAD FACTOR	4.5
*EFFICIENCY HOVER	0.85	ASPECT RATIO	7.34	EMPENNAGE	2114.	*FLIGHT CREW	2.
* CONVER	0.83	SPAN (FT)	105.1	LANDING GEAR	32[illegible]2.	*CABIN CREW	3.
CRUISE	0.79	MEAN CHORD (FT)	14.32	FLIGHT CONTROLS	661[illegible].	*ATC SPEED LIMIT	YES
HEL MODE WEIGHT (LB)	10755.	*THICKNESS/CHORD RATIO	0.210	HYDRAULICS	426.		
AIRPLANE WEIGHT (LB)	9767.	*TAPER RATIO	0.70	ELECTRICAL	2475.		
*TIP SPEED HOVER	630.	SWEEP (DEG)	-5.4	INST-+AVIONICS	949.		
* CRUISE	540.	CRUISE LIFT COEFF	0.23	AIR CONDITIONING	1930.		
*FUSELAGE CLEARANCE (FT)	1.0	MAX LIFT COEFF CONVER	1.00	FURNISHINGS	4900.		
*MAX HEL MODE ADV RATIO	0.40	*MAX LIFT COEFF CLEAN	1.40	FLUIDS	542.		
		*FLAP AREA/WING AREA	0.25	FLIGHT CREW	400.		
* INDICATES INPUT VARIABLE		CLIMB SPD/CONVER SPD	0.96	CABIN CREW	450.		

DESIGN MISSION	SPEED MPH	HEIGHT FT	DIST MI	TIME MIN	FUEL LB
TAKEOFF & LANDING				2.00	183.
ACCEL. & CONV.		1500.	1.3	0.98	113.
AIRPLANE CLIMB	164.,262.	13500.	12.9	4.22	460.
ACCEL. TO CRUISE			14.7	2.47	286.
CRUISE	438.		429.8	58.50	5781.
AIRPLANE DESCENT	438.,301.	12000.	31.4	5.37	72.
APPROACH		3000.	9.9	3.99	65.
TOTAL			500.0	77.89	6960.
RESERVE				20.00	1825.

TILT ROTOR DESIGN PROGRAM 1974

C-75-50 DESIGN ITERATIONS: 5

OVERALL		POWERPLANT		FUSELAGE		STRUCT TECHNOLOGY FACTORS	
GROSS WEIGHT (LB)	48857.	INST NORMAL PWR (HP)	9183.	*LENGTH (FT)	80.0	*ROTOR	1.05
EMPTY WEIGHT (LB)	34316.	*NUMBER OF ENGINES	2.	*DIAMETER (FT)	10.0	*TRANSMISSION	0.85
FUEL WEIGHT (LB)	4385.	*EXCESS FACTOR HEL MODE	1.40	*DRAG FACTOR	1.00	*AIRFRAME	0.80
PAYLOAD (LB)	10150.	*% RATED EMRG HVR	140.			*ENGINE (HP/LB)	7.00
CRUISE SPEED (MPH)	420.	* CONV + CLIMB	120.	FLAT PLATE AREAS (SF)		*ENGINE INSTALLATION	1.72
L/D CRUISE	9.98	* CRUISE	93.	WING PROFILE	4.45		
*RANGE (STAT MI)	500.	INST PWR EMRG HVR (HP)	9183.	FUSELAGE	5.29	DESIGN MISSION	
*PASSENGER SEATS	50.	CONVER (HP)	6563.	EMPENNAGE	2.67	*FIELD ELEVATION (FT)	0.
*CARGO (LB)	0.	CRUISE (HP)	8515.	TOTAL PROFILE	15.02	SOUND SPEED HVR (FPS)	1117.
		*SFC (LB/HP HR)	0.420	WING INDUCED	1.93	*STD DAY TEMP (DEG F)	59.
ROTORS						*EMERG HOVER ALT (FT)	2000.
*DISC LOADING (PSF)	8.50	DRIVE SYSTEM		COMPONENT WEIGHTS (LB)		*HOT DAY TEMP (DEG F)	95.
RADIUS (FT)	30.2	*EFFICIENCY	0.97	ROTORS	4774.	*CT/SIG MAX	0.150
SOLIDITY	0.098	HEL MODE WEIGHT (LB)	5049.	DRIVE SYSTEM	5781.	*MAX ACCELERATION (G)	0.25
BLADE CHORD (FT)	3.11	AIRPLANE WEIGHT (LB)	5781.	POWERPLANT	2256.	*DESIGN CRUISE (MPH)	410.
TOTAL BLADES	6			NACELLES	513.	*CRUISE ALTITUDE (FT)	15000.
*CT/SIG HOVER	0.120	WING		FUEL SYSTEM	383.	SOUND SPEED CRSE (FPS)	1058.
*PROFILE DRAG COEFF	0.010	AREA (SF)	679.	WING	4352.	*MAX DECELERATION (G)	0.20
% DOWNLOAD	9.7	*LOADING (PSF)	72.0	FUSELAGE	5798.	*STRUCT LOAD FACTOR	4.5
*EFFICIENCY HOVER	0.93	ASPECT RATIO	7.74	EMPENNAGE	977.	*FLIGHT CREW	2.
* CONVER	0.81	SPAN (FT)	72.5	LANDING GEAR	1466.	*CABIN CREW	1.
CRUISE	0.80	MEAN CHORD (FT)	9.36	FLIGHT CONTROLS	2174.	*ATC SPEED LIMIT	YES
HEL MODE WEIGHT (LB)	4774.	*THICKNESS/CHORD RATIO	0.210	HYDRAULICS	286.		
AIRPLANE WEIGHT (LB)	4328.	*TAPER RATIO	0.70	ELECTRICAL	802.		
*TIP SPEED HOVER	630.	SWEEP (DEG)	-5.3	INSTR+AVIONICS	703.		
* CRUISE	540.	CRUISE LIFT COEFF	0.25	AIR CONDITIONING	1150.		
*FUSELAGE CLEARANCE (FT)	1.0	MAX LIFT COEFF CONVER	1.03	FURNISHINGS	2500.		
*MAX HEL MODE ADV RATIO	0.40	*MAX LIFT COEFF CLEAN	1.40	FLUIDS	244.		
		*FLAP AREA/WING AREA	0.25	FLIGHT CREW	400.		
* INDICATES INPUT VARIABLE		CLIMB SPD/CONVER SPD	0.91	CABIN CREW	150.		

DESIGN MISSION	SPEED MPH	HEIGHT FT	DIST MI	TIME MIN	FUEL LB
TAKEOFF & LANDING				2.00	88.
ACCEL. & CONV.		1500.	1.3	1.03	58.
AIRPLANE CLIMB	156.,192.	13500.	12.3	4.23	222.
ACCEL. TO CRUISE			14.0	2.43	135.
CRUISE	420.		434.2	62.01	2934.
AIRPLANE DESCENT	420.,301.	12000.	28.4	4.91	32.
APPROACH		3000.	9.9	3.95	32.
TOTAL			500.0	80.55	3501.
RESERVE				20.00	884.

TILT ROTOR DESIGN PROGRAM 1974

0-85-50 DESIGN ITERATIONS: 4

OVERALL	
GROSS WEIGHT (LB)	42159.
EMPTY WEIGHT (LB)	28598.
FUEL WEIGHT (LB)	3411.
PAYLOAD (LB)	10150.
CRUISE SPEED (MPH)	411.
L/D CRUISE	9.84
*RANGE (STAT MI)	500.
*PASSENGER SEATS	50.
*CARGO (LB)	0.
ROTORS	
*DISC LOADING (PSF)	8.50
RADIUS (FT)	28.1
SOLIDITY	0.098
BLADE CHORD (FT)	2.88
TOTAL BLADES	6
*CT/SIG HOVER	0.120
*PROFILE DRAG COEFF	0.010
% DOWNLOAD	9.6
*EFFICIENCY HOVER	0.87
* CONVER	0.85
CRUISE	0.80
HEL MODE WEIGHT (LB)	3620.
AIRPLANE WEIGHT (LB)	3313.
*TIP SPEED HOVER	630.
* CRUISE	540.
*FUSELAGE CLEARANCE (FT)	1.0
*MAX HEL MODE ADV RATIO	0.40

POWERPLANT	
INST NORMAL PWR (HP)	7803.
*NUMBER OF ENGINES	2.
*EXCESS FACTOR HEL MODE	1.40
*% RATED EMRG HVR	140.
* CONV + CLIMB	120.
* CRUISE	93.
INST PWR EMRG HVR (HP)	7558.
CONVER (HP)	572[illegible].
CRUISE (HP)	7803.
*SFC (LB/HP HR)	0.380
DRIVE SYSTEM	
*EFFICIENCY	0.97
HEL MODE WEIGHT (LB)	3882.
AIRPLANE WEIGHT (LB)	4550.
WING	
AREA (SF)	586.
*LOADING (PSF)	72.0
ASPECT RATIO	7.94
SPAN (FT)	68.2
MEAN CHORD (FT)	8.59
*THICKNESS/CHORD RATIO	0.210
*TAPER RATIO	0.70
SWEEP (DEG)	-5.3
CRUISE LIFT COEFF	0.26
MAX LIFT COEFF CONVER	1.00
*MAX LIFT COEFF CLEAN	1.40
*FLAP AREA/WING AREA	0.25
CLIMB SEL/CONVER SPD	0.89

FUSELAGE	
*LENGTH (FT)	80.0
*DIAMETER (FT)	10.0
*DRAG FACTOR	1.00
FLAT PLATE AREAS (SF)	
WING PROFILE	3.89
FUSELAGE	5.29
EMPENNAGE	2.33
TOTAL PROFILE	13.93
WING INDUCED	1.84
COMPONENT WEIGHTS (LB)	
ROTORS	3620.
DRIVE SYSTEM	4550.
POWERPLANT	1342.
NACELLES	143.
FUEL SYSTEM	249.
WING	3806.
FUSELAGE	5388.
EMPENNAGE	801.
LANDING GEAR	1265.
FLIGHT CONTROLS	1766.
HYDRAULICS	266.
ELECTRICAL	651.
INSTR+AVIONICS	703.
AIR CONDITIONING	1150.
FURNISHINGS	2500.
FLUIDS	211.
FLIGHT CREW	400.
CABIN CREW	150.

STRUCT TECHNOLOGY FACTORS	
*ROTOR	0.95
*TRANSMISSION	0.81
*AIRFRAME	0.76
*ENGINE (HP/LB)	10.00
*ENGINE INSTALLATION	1.72
DESIGN MISSION	
*FIELD ELEVATION (FT)	0.
SOUND SPEED HVR (FPS)	1117.
*STD DAY TEMP (DEG F)	59.
*EMERG HOVER ALT (FT)	2000.
*HOT DAY TEMP (DEG F)	95.
*CT/SIG MAX	0.150
*MAX ACCELERATION (G)	0.25
*DESIGN CRUISE (MPH)	410.
*CRUISE ALTITUDE (FT)	15000.
SOUND SPEED CRSE (FPS)	1058.
*MAX DECELERATION (G)	0.20
*STRUCT LOAD FACTOR	4.5
*FLIGHT CREW	2.
*CABIN CREW	1.
*ATC SPEED LIMIT	YES

* INDICATES INPUT VARIABLE

DESIGN MISSION	SPEED MPH	HEIGHT FT	DIST MI	TIME MIN	FUEL LB
TAKEOFF & LANDING				2.00	66.
ACCEL. & CONV.		1500.	1.3	1.05	44.
AIRPLANE CLIMB	153.,188.	13500.	11.5	4.06	164.
ACCEL. TO CRUISE			12.1	2.17	93.
CRUISE	411.		437.9	63.99	2333.
AIRPLANE DESCENT	411.,301.	12000.	27.3	4.75	24.
APPROACH		3000.	9.9	3.95	24.
TOTAL			500.0	81.97	2748.
RESERVE				20.00	662.

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TILT ROTOR DESIGN PROGRAM 1974

D-80-20                                                                    DESIGN ITERATIONS:  3

OVERALL                                POWERPLANT                          FUSELAGE                                STRUCT TECHNOLOGY FACTORS
  GROSS WEIGHT (LB)         20886.       INST NORMAL PWR (HP)     4199.     *LENGTH (FT)                  55.0     *ROTOR                      1.00
  EMPTY WEIGHT (LB)         14987.      *NUMBER OF ENGINES           2.     *DIAMETER (FT)                 8.5     *TRANSMISSION               0.83
  FUEL WEIGHT (LB)           1899.      *EXCESS FACTOR HEL MODE    1.45     *DRAG FACTOR                  1.00     *AIRFRAME                   0.78
  PAYLOAD (LB)               4000.      *% RATED EMRG HVR          140.                                            *ENGINE (HP/LB)             8.50
  CRUISE SPEED (MPH)          401.      *        CONV + CLIMB      120.    FLAT PLATE AREAS (SF)                   *ENGINE INSTALLATION        2.02
  L/D CRUISE                 8.55       *        CRUISE             90.     WING PROFILE                  2.35
 *RANGE (STAT MI)             500.       INST PWR EMRG HVR (HP)   3497.     FUSELAGE                      3.38    DESIGN MISSION
 *PASSENGER SEATS              20.                CONVER   (HP)   2748.     EMPENNAGE                     1.41     *FIELD ELEVATION (FT)          0.
 *CARGO (LB)                    0.                CRUISE   (HP)   4199.     TOTAL PROFILE                 8.65      SOUND SPEED HVR  (FPS)     1117.
                                        *SFC (LB/HP HR)           0.400     WING INDUCED                  0.79     *STD DAY TEMP (DEG F)         59.
ROTORS                                                                                                             *EMERG HOVER ALT (FT)       2000.
 *DISC LOADING (PSF)          7.00     DRIVE SYSTEM                        COMPONENT WEIGHTS (LB)                  *HOT DAY TEMP (DEG F)         95.
  RADIUS (FT)                 21.8      *EFFICIENCY                0.97     ROTORS                        1828.    *CT/SIG MAX                 0.150
  SOLIDITY                   0.087       HEL MODE WEIGHT (LB)     1863.     DRIVE SYSTEM                  2337.    *MAX ACCELERATION (G)       0.25
  BLADE CHORD (FT)            1.99       AIRPLANE WEIGHT (LB)     2337.     POWERPLANT                     998.    *DESIGN CRUISE (MPH)        400.
  TOTAL BLADES                   6                                          NACELLES                        73.    *CRUISE ALTITUDE (FT)     15000.
 *CT/SIG HOVER               0.120     WING                                 FUEL SYSTEM                     91.     SOUND SPEED CRSE (FPS)    1058.
 *PROFILE DRAG COEFF         0.010       AREA (SF)                 337.     WING                          1779.    *MAX DECELERATION (G)       0.20
  % DOWNLOAD                   8.9      *LOADING (PSF)             62.0     FUSELAGE                      2724.    *STRUCT LOAD FACTOR          4.5
 *EFFICIENCY HOVER            0.85       ASPECT RATIO              8.68     EMPENNAGE                      407.    *FLIGHT CREW                  2.
 *           CONVER           0.83       SPAN (FT)                 54.1     LANDING GEAR                   627.    *CABIN CREW                   0.
             CRUISE           0.83       MEAN CHORD (FT)           6.23     FLIGHT CONTROLS                656.    *ATC SPEED LIMIT             YES
  HEL MODE WEIGHT (LB)       1828.      *THICKNESS/CHORD RATIO    0.210     HYDRAULICS                     187.
  AIRPLANE WEIGHT (LB)       1793.      *TAPER RATIO               0.70     ELECTRICAL                     241.
 *TIP SPEED HOVER             605.       SWEEP (DEG)               -5.2     INSTR+AVIONICS                 580.
 *          CRUISE            540.       CRUISE LIFT COEFF         0.24     AIR CONDITIONING               760.
 *FUSELAGE CLEARNCE (FT)       1.0       MAX LIFT COEFF CONVER     0.93     FURNISHINGS                   1300.
 *MAX HEL MODE ADV RATIO      0.40      *MAX LIFT COEFF CLEAN      1.40     FLUIDS                         104.
                                        *FLAP ARE /WING AREA       0.25     FLIGHT CREW                    400.
 * INDICATES INPUT VARIABLE              CLIMB SPD/CONVER SPD      0.82     CABIN CREW                       0.

DESIGN MISSION             SPEED       HEIGHT    DIST     TIME      FUEL
                            MPH          FT       MI       MIN       LB
  TAKEOFF & LANDING                                        2.00      33.
  ACCEL. & CONV.                        1500.     1.6      1.38      30.
  AIRPLANE CLIMB          136.,167.    13500.     9.0      3.56      80.
  ACCEL. TO CRUISE                               10.9      2.00      48.
  CRUISE                      401.              445.4     66.75    1348.
  AIRPLANE DESCENT        400.,301.    12000.    23.2      4.37      11.
  APPROACH                              3000.    10.0      3.99      14.

   TOTAL                                        500.0     83.74    1564.

  RESERVE                                                 20.00     334.
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TILT ROTOR DESIGN PROGRAM 1974

D-80-50 DESIGN ITERATIONS: 4

OVERALL		POWERPLANT		FUSELAGE		STRUCT TECHNOLOGY FACTORS	
GROSS WEIGHT (LB)	45116.	INST NORMAL PWR (HP)	7913.	*LENGTH (FT)	80.0	*ROTOR	1.00
EMPTY WEIGHT (LB)	31334.	*NUMBER OF ENGINES	2.	*DIAMETER (FT)	10.0	*TRANSMISSION	0.93
FUEL WEIGHT (LB)	3633.	*EXCESS FACTOR HEL MODE	1.40	*DRAG FACTOR	1.00	*AIRFRAME	0.78
PAYLOAD (LB)	10150.	*% RATED EMRG HVR	140.			*ENGINE (HP/LB)	8.50
CRUISE SPEED (MPH)	401.	* CONV + CLIMB	120.	FLAT PLATE AREAS (SF)		*ENGINE INSTALLATION	1.50
L/D CRUISE	9.54	* CRUISE	90.	WING PROFILE	4.78		
*RANGE (STAT MI)	500.	INST PWR RQRD HVR (HP)	7565.	FUSELAGE	5.31	DESIGN MISSION	
*PASSENGER SEATS	50.	CONVER (HP)	5741.	EMPENNAGE	2.97	*FIELD ELEVATION (FT)	0.
*CARGO (LB)	0.	CRUISE (HP)	7813.	TOTAL PROFILE	15.67	SOUND SPEED HVR (FPS)	1117.
		*SFC (LB/HP HR)	0.400	WING INDUCED	1.87	*STD DAY TEMP (DEG F)	59.
ROTORS						*EMERG HOVER ALT (FT)	2000.
*DISC LOADING (PSF)	7.00	DRIVE SYSTEM		COMPONENT WEIGHTS (LB)		*HOT DAY TEMP (DEG F)	95.
RADIUS (FT)	32.0	*EFFICIENCY	0.97	ROTORS	4179.	*CT/SIG MAX	0.150
SOLIDITY	0.087	HEL MODE WEIGHT (LB)	4558.	DRIVE SYSTEM	[illegible]44.	*MAX ACCELERATION (G)	0.25
BLADE CHORD (FT)	2.91	AIRPLANE WEIGHT (LB)	5244.	POWERPLANT	1379.	*DESIGN CRUISE (MPH)	400.
TOTAL BLADES	6			NACELLES	156.	*CRUISE ALTITUDE (FT)	15000.
*CT/SIG HOVER	0.120	WING		FUEL SYSTEM	277.	SOUND SPEED CRSE (FPS)	1058.
*PROFILE DRAG COEFF	0.010	AREA (SF)	728.	WING	4592.	*MAX DECELERATION (G)	0.20
% DOWNLOAD	5.4	*LOADING (PSF)	62.0	FUSELAGE	5586.	*STRUCT LOAD FACTOR	4.5
*EFFICIENCY HOVER	0.85	ASPECT RATIO	7.55	EMPENNAGE	880.	*FLIGHT CREW	2.
* CONVER	0.83	SPAN (FT)	76.1	LANDING GEAR	1354.	*CABIN CREW	1.
CRUISE	0.83	MEAN CHORD (FT)	9.57	FLIGHT CONTROLS	1543.	*ATC SPEED LIMIT	YES
HEL MODE WEIGHT (LB)	4179.	*THICKNESS/CHORD RATIO	0.210	HYDRAULICS	275.		
AIRPLANE WEIGHT (LB)	3940.	*TAPER RATIO	0.70	ELECTRICAL	717.		
*TIP SPEED HOVER	607.	SWEEP (DEG)	-5.3	INSTR+AVIONICS	703.		
* CRUISE	540.	CRUISE LIFT COEFF	0.24	AIR CONDITIONING	1150.		
*FUSELAGE CLEARANCE (FT)	1.0	MAX LIFT COEFF CONVER	0.93	FURNISHINGS	2500.		
*MAX HEL MODE ADV RATIO	0.40	*MAX LIFT COEFF CLEAN	1.40	FLUIDS	226.		
		*FLAP AREA/WING AREA	0.25	FLIGHT CREW	400.		
* INDICATES INPUT VARIABLE		CLIMB SPD/CONVER SPD	0.88	CABIN CREW	150.		

DESIGN MISSION	SPEED MPH	HEIGHT FT	DIST MI	TIME MIN	FUEL LB
TAKEOFF & LANDING				2.00	70.
ACCEL. & CONV.		1500.	1.4	1.16	51.
AIRPLANE CLIMB	145.-175.	13500.	11.7	4.33	183.
ACCEL. TO CRUISE			13.1	2.35	107.
CRUISE	401.		437.1	65.49	2473.
AIRPLANE DESCENT	401.-301.	12000.	27.0	4.73	24.
APPROACH		3000.	5.7	3.87	25.
TOTAL			500.0	83.57	2934.
RESERVE				20.00	699.

TILT ROTOR DESIGN PROGRAM 1974

D-80-83

DESIGN ITERATIONS: 6

OVERALL	
GROSS WEIGHT (LB)	75976.
EMPTY WEIGHT (LB)	53802.
FUEL WEIGHT (LB)	5874.
PAYLOAD (LB)	16300.
CRUISE SPEED (MPH)	409.
L/D CRUISE	10.54
*RANGE (STAT MI)	500.
*PASSENGER SEATS	80.
*CARGO (LB)	0.
ROTORS	
*DISC LOADING (PSF)	7.00
RADIUS (FT)	41.6
SOLIDITY	0.088
BLADE CHORD (FT)	3.81
TOTAL BLADES	6
*CT/SIG HOVER	0.120
*PROFILE DRAG COEFF	0.010
% DOWNLOAD	9.6
*EFFICIENCY HOVER	0.85
* CONVER	0.83
CRUISE	0.82
HEL MODE WEIGHT (LB)	7392.
AIRPLANE WEIGHT (LB)	6923.
*TIP SPEED HOVER	605.
* CRUISE	540.
*FUSELAGE CLEARANCE (FT)	1.0
*MAX HEL MODE ADV RATIO	0.40

POWERPLANT	
INST NORMAL PWR (HP)	12740.
*NUMBER OF ENGINES	2.
*EXCESS FACTOR HEL MODE	1.40
*% RATED EMRG HVR	140.
* CONV + CLIMB	120.
* CRUISE	90.
INST PWR EMRG HVR (HP)	12740.
CONVER (HP)	9668.
CRUISE (HP)	11920.
*SFC (LB/HP HR)	0.400
DRIVE SYSTEM	
*EFFICIENCY	0.97
HEL MODE WEIGHT (LB)	8542.
AIRPLANE WEIGHT (LB)	9594.
WING	
AREA (SF)	1225.
*LOADING (PSF)	62.0
ASPECT RATIO	7.62
SPAN (FT)	96.6
MEAN CHORD (FT)	12.68
*THICKNESS/CHORD RATIO	0.210
*TAPER RATIO	0.70
SWEEP (DEG)	-5.3
CRUISE LIFT COEFF	0.23
MAX LIFT COEFF CONVER	0.93
*MAX LIFT COEFF CLEAN	1.40
*FLAP AREA/WING AREA	0.25
CLIMB SPD/CONVER SPD	0.92

FUSELAGE	
*LENGTH (FT)	95.0
*DIAMETER (FT)	11.5
*DRAG FACTOR	1.00
FLAT PLATE AREAS (SF)	
WING PROFILE	7.73
FUSELAGE	7.04
EMPENNAGE	4.64
TOTAL PROFILE	23.48
WING INDUCED	2.95
COMPONENT WEIGHTS (LB)	
ROTORS	7392.
DRIVE SYSTEM	9594.
POWERPLANT	3028.
NACELLES	1003.
FUEL SYSTEM	632.
WING	7925.
FUSELAGE	8094.
EMPENNAGE	1482.
LANDING GEAR	2279.
FLIGHT CONTROLS	4052.
HYDRAULICS	357.
ELECTRICAL	1499.
INSTR+AVIONICS	826.
AIR CONDITIONING	1540.
FURNISHINGS	3700.
FLUIDS	380.
FLIGHT CREW	490.
CABIN CREW	300.

STRUCT TECHNOLOGY FACTORS	
*ROTOR	1.00
*TRANSMISSION	0.83
*AIRFRAME	0.78
*ENGINE (HP/LB)	8.50
*ENGINE INSTALLATION	2.02
DESIGN MISSION	
*FIELD ELEVATION (FT)	0.
SOUND SPEED HVR (FPS)	1117.
*STD DAY TEMP (DEG F)	59.
*EMERG HOVER ALT (FT)	2000.
*HOT DAY TEMP (DEG F)	95.
*CT/SIG MAX	0.150
*MAX ACCELERATION (G)	0.25
*DESIGN CRUISE (MPH)	400.
*CRUISE ALTITUDE (FT)	15000.
SOUND SPEED CRSE (FPS)	1058.
*MAX DECELERATION (G)	0.20
*STRUCT LOAD FACTOR	4.5
*FLIGHT CREW	2.
*CABIN CREW	2.
*ATC SPEED LIMIT	YES

* INDICATES INPUT VARIABLE

DESIGN MISSION	SPEED MPH	HEIGHT FT	DIST MI	TIME MIN	FUEL LB
TAKEOFF & LANDING				2.00	117.
ACCEL. & CONV.		1500.	1.6	1.24	92.
AIRPLANE CLIMB	151..186.	13500.	12.6	4.50	311.
ACCEL. TO CRUISE			13.8	2.46	180.
CRUISE	409.		432.8	63.52	3920.
AIRPLANE DESCENT	409..301.	12000.	29.3	5.11	43.
APPROACH		3000.	10.0	3.99	42.
TOTAL			500.0	82.82	4705.
RESERVE				20.00	1169.

TILT ROTOR DESIGN PROGRAM 1974

D-80-110

DESIGN ITERATIONS: 5

OVERALL	
GROSS WEIGHT (LB)	113369.
EMPTY WEIGHT (LB)	82327.
FUEL WEIGHT (LB)	9592.
PAYLOAD (LB)	22450.
CRUISE SPEED (MPH)	420.
L/D CRUISE	10.88
*RANGE (STAT MI)	500.
*PASSENGER SEATS	110.
*CARGO (LB)	0.
ROTORS	
*DISC LOADING (PSF)	7.00
RADIUS (FT)	50.8
SOLIDITY	0.088
BLADE CHORD (FT)	4.66
TOTAL BLADES	6
*CT/SIG HOVER	0.120
*PROFILE DRAG COEFF	0.010
% DOWNLOAD	9.7
*EFFICIENCY HOVER	0.85
* CONVER	0.83
CRUISE	0.82
HEL MODE WEIGHT (LB)	11436.
AIRPLANE WEIGHT (LB)	12719.
*TIP SPEED HOVER	695.
* CRUISE	540.
*FUSELAGE CLEARANCE (FT)	1.0
*MAX HEL MODE ADV RATIO	0.40

POWERPLANT	
INST NORMAL PWR (HP)	19016.
*NUMBER OF ENGINES	2.
*EXCESS FACTOR HEL MODE	1.40
*% RATED EMRG HVR	140.
* CONV + CLIMB	120.
* CRUISE	90.
INST PWR EMRG HVR (HP)	19016.
CONVER (HP)	14430.
CRUISE (HP)	16737.
*SFC (LB/HP HR)	0.400
DRIVE SYSTEM	
*EFFICIENCY	0.97
HEL MODE WEIGHT (LB)	13811.
AIRPLANE WEIGHT (LB)	15544.
WING	
AREA (SF)	1829.
*LOADING (PSF)	62.0
ASPECT RATIO	7.43
SPAN (FT)	116.5
MEAN CHORD (FT)	15.69
*THICKNESS/CHORD RATIO	0.210
*TAPER RATIO	0.70
SWEEP (DEG)	-5.4
CRUISE LIFT COEFF	0.22
MAX LIFT COEFF CONVER	0.93
*MAX LIFT COEFF CLEAN	1.40
*FLAP AREA/WING AREA	0.25
CLIMB SPD/CONVER SPD	0.94

FUSELAGE	
*LENGTH (FT)	110.0
*DIAMETER (FT)	13.0
*DRAG FACTOR	1.00
FLAT PLATE AREAS (SF)	
WING PROFILE	11.19
FUSELAGE	9.00
EMPENNAGE	6.71
TOTAL PROFILE	32.54
WING INDUCED	4.18
COMPONENT WEIGHTS (LB)	
ROTORS	11436.
DRIVE SYSTEM	15544.
POWERPLANT	4519.
NACELLES	2585.
FUEL SYSTEM	1212.
WING	11995.
FUSELAGE	11043.
EMPENNAGE	2211.
LANDING GEAR	3401.
FLIGHT CONTROLS	7125.
HYDRAULICS	436.
ELECTRICAL	2642.
INSTR+AVIONICS	949.
AIR CONDITIONING	1930.
FURNISHINGS	4900.
FLUIDS	567.
FLIGHT CREW	406.
CABIN CREW	450.

STRUCT TECHNOLOGY FACTORS	
*ROTOR	1.00
*TRANSMISSION	0.83
*AIRFRAME	0.78
*ENGINE (HP/LB)	8.50
*ENGINE INSTALLATION	2.02
DESIGN MISSION	
*FIELD ELEVATION (FT)	0.
SOUND SPEED HVR (FPS)	1117.
*STD DAY TEMP (DEG F)	59.
*EMERG HOVER ALT (FT)	2000.
*HOT DAY TEMP (DEG F)	95.
*CT/SIG MAX	0.150
*MAX ACCELERATION (G)	0.25
*DESIGN CRUISE (MPH)	400.
*CRUISE ALTITUDE (FT)	15000.
SOUND SPEED CRSE (FPS)	1058.
*MAX DECELERATION (G)	0.20
*STRUCT LOAD FACTOR	4.5
*FLIGHT CREW	2.
*CABIN CREW	3.
*ATC SPEED LIMIT	YES

* INDICATES INPUT VARIABLE

DESIGN MISSION	SPEED MPH	HEIGHT FT	DIST MI	TIME MIN	FUEL LB
TAKEOFF & LANDING				2.00	175.
ACCEL. & CONV.		1500.	1.6	1.21	134.
AIRPLANE CLIMB	155..191.	13500.	12.9	4.49	464.
ACCEL. TO CRUISE			14.8	2.58	283.
CRUISE	420.		429.9	61.38	5662.
AIRPLANE DESCENT	420..301.	12000.	30.9	5.34	67.
APPROACH		3000.	10.0	3.99	63.
TOTAL			500.0	80.99	6847.
RESERVE				20.00	1745.

TILT ROTOR DESIGN PROGRAM 1974

D-75-50

DESIGN ITERATIONS: 5

OVERALL

GROSS WEIGHT (LB)	50338.
EMPTY WEIGHT (LB)	35983.
FUEL WEIGHT (LB)	4205.
PAYLOAD (LB)	10150.
CRUISE SPEED (MPH)	407.
L/D CRUISE	10.19
*RANGE (STAT MI)	500.
*PASSENGER SEATS	50.
*CARGO (LB)	0.

ROTORS

*DISC LOADING (PSF)	7.00
RADIUS (FT)	33.8
SOLIDITY	0.088
BLADE CHORD (FT)	3.10
TOTAL BLADES	6
*CT/SIG HOVER	0.120
*PROFILE DRAG COEFF	0.010
% DOWNLOAD	9.5
*EFFICIENCY HOVER	0.83
* CONVER	0.81
CRUISE	0.82
HEL MODE WEIGHT (LB)	4995.
AIRPLANE WEIGHT (LB)	4675.
*TIP SPEED HOVER	605.
* CRUISE	540.
*FUSELAGE CLEARNCE (FT)	1.3
*MAX HEL MODE ADV RATIO	0.40

POWERPLANT

INST NORMAL PWR (HP)	8642.
*NUMBER OF ENGINES	2.
*EXCESS FACTOR HEL MODE	1.40
*% RATED EMRG HVR	140.
* CONV + CLIMB	120.
* CRUISE	90.
INST PWR EMRG HVR (HP)	8642.
CONVER (HP)	6558.
CRUISE (HP)	8357.
*SFC (LB/HP HR)	0.420

DRIVE SYSTEM

*EFFICIENCY	0.97
HEL MODE WEIGHT (LB)	5439.
AIRPLANE WEIGHT (LB)	6098.

WING

AREA (SF)	812.
*LOADING (PSF)	62.0
ASPECT RATIO	7.82
SPAN (FT)	79.7
MEAN CHORD (FT)	10.19
*THICKNESS/CHORD RATIO	0.210
*TAPER RATIO	0.70
SWEEP (DEG)	-5.3
CRUISE LIFT COEFF	0.23
MAX LIFT COEFF CONVER	0.93
*MAX LIFT COEFF CLEAN	1.40
*FLAP AREA/WING AREA	0.25
CLIMB SPD/CONVER SPD	0.89

FUSELAGE

*LENGTH (FT)	80.0
*DIAMETER (FT)	10.0
*DRAG FACTOR	1.00

FLAT PLATE AREAS (SF)

WING PROFILE	5.28
FUSELAGE	5.31
EMPENNAGE	3.17
TOTAL PROFILE	16.65
WING INDUCED	2.03

COMPONENT WEIGHTS (LB)

ROTORS	4995.
DRIVE SYSTEM	6398.
POWERPLANT	2494.
NACELLES	650.
FUEL SYSTEM	356.
WING	4900.
FUSELAGE	5824.
EMPENNAGE	1007.
LANDING GEAR	1510.
FLIGHT CONTROLS	2268.
HYDRAULICS	290.
ELECTRICAL	837.
INSTR+AVIONICS	703.
AIR CONDITIONING	1150.
FURNISHINGS	2500.
FLUIDS	252.
FLIGHT CREW	400.
CABIN CREW	150.

STRUCT TECHNOLOGY FACTORS

*ROTOR	1.05
*TRANSMISSION	0.85
*AIRFRAME	0.80
*ENGINE (HP/LB)	7.00
*ENGINE INSTALLATION	2.02

DESIGN MISSION

*FIELD ELEVATION (FT)	0.
SOUND SPEED HVR (FPS)	1117.
*STD DAY TEMP (DEG F)	59.
*EMERG HOVER ALT (FT)	2000.
*HOT DAY TEMP (DEG F)	95.
*CT/SIG MAX	0.150
*MAX ACCELERATION (G)	0.25
*DESIGN CRUISE (MPH)	400.
*CRUISE ALTITUDE (FT)	15000.
SOUND SPEED CRSE (FPS)	1058.
*MAX DECELERATION (G)	0.20
*STRUCT LOAD FACTOR	4.5
*FLIGHT CREW	2.
*CABIN CREW	1.
*ATC SPEED LIMIT	YES

* INDICATES INPUT VARIABLE

DESIGN MISSION	SPEED MPH	HEIGHT FT	DIST MI	TIME MIN	FUEL LB
TAKEOFF & LANDING				2.00	83.
ACCEL. & CONV.		1500.	1.6	1.27	67.
AIRPLANE CLIMB	148.,182.	13500.	12.3	4.51	221.
ACCEL. TO CRUISE			14.9	2.66	139.
CRUISE	407.		433.3	63.94	2803.
AIRPLANE DESCENT	407.,301.	12000.	27.9	4.87	29.
APPROACH		3000.	10.0	3.99	30.
TOTAL			500.0	83.24	3372.
RESERVE				20.00	833.

TILT ROTOR DESIGN PROGRAM 1974

D-85-50

DESIGN ITERATIONS: 4

OVERALL	
GROSS WEIGHT (LB)	43779.
EMPTY WEIGHT (LB)	30262.
FUEL WEIGHT (LB)	3367.
PAYLOAD (LB)	10150.
CRUISE SPEED (MPH)	401.
L/D CRUISE	9.82
*RANGE (STAT MI)	500.
*PASSENGER SEATS	50.
*CARGO (LB)	0.

ROTORS	
*DISC LOADING (PSF)	7.00
RADIUS (FT)	31.6
SOLIDITY	0.087
BLADE CHORD (FT)	2.89
TOTAL BLADES	6
*CT/SIG HOVER	0.120
*PROFILE DRAG COEFF	0.010
% DOWNLOAD	9.3
*EFFICIENCY HOVER	0.87
* CONVER	0.85
CRUISE	0.83
HEL MODE WEIGHT (LB)	3819.
AIRPLANE WEIGHT (LB)	3653.
*TIP SPEED HOVER	605.
* CRUISE	540.
*FUSELAGE CLEARNCE (FT)	1.0
*MAX HEL MODE ADV RATIO	0.40

* INDICATES INPUT VARIABLE

POWERPLANT	
INST NORMAL PWR (HP)	7667.
*NUMBER OF ENGINES	2.
*EXCESS FACTOR HEL MODE	1.40
*% RATED EMRG HVR	140.
* CONV + CLIMB	120.
* CRUISE	90.
INST PWR EMRG HVR (HP)	7168.
CONVER (HP)	5440.
CRUISE (HP)	7667.
*SFC (LB/HP HR)	0.380

DRIVE SYSTEM	
*EFFICIENCY	0.97
HEL MODE WEIGHT (LB)	4221.
AIRPLANE WEIGHT (LB)	4986.

WING	
AREA (SF)	706.
*LOADING (PSF)	62.0
ASPECT RATIO	7.99
SPAN (FT)	75.1
MEAN CHORD (FT)	9.40
*THICKNESS/CHORD RATIO	0.210
*TAPER RATIO	0.70
SWEEP (DEG)	-5.3
CRUISE LIFT COEFF	0.24
MAX LIFT COEFF CONVER	0.93
*MAX LIFT COEFF CLEAN	1.40
*FLAP AREA/WING AREA	0.25
CLIMB SPD/CONVER SPD	0.88

FUSELAGE	
*LENGTH (FT)	80.0
*DIAMETER (FT)	10.0
*DRAG FACTOR	1.00

FLAT PLATE AREAS (SF)	
WING PROFILE	4.65
FUSELAGE	5.31
EMPENNAGE	2.79
TOTAL PROFILE	15.42
WING INDUCED	1.80

COMPONENT WEIGHTS (LB)	
ROTORS	3819.
DRIVE SYSTEM	4986.
POWERPLANT	1549.
NACELLES	200.
FUEL SYSTEM	243.
WING	4328.
FUSELAGE	5418.
EMPENNAGE	832.
LANDING GEAR	1313.
FLIGHT CONTROLS	1863.
HYDRAULICS	271.
ELECTRICAL	687.
INSTR+AVIONICS	703.
AIR CONDITIONING	1150.
FURNISHINGS	2500.
FLUIDS	219.
FLIGHT CREW	400.
CABIN CREW	150.

STRUCT TECHNOLOGY FACTORS	
*ROTOR	0.95
*TRANSMISSION	0.81
*AIRFRAME	0.76
*ENGINE (HP/LB)	10.00
*ENGINE INSTALLATION	2.02

DESIGN MISSION	
*FIELD ELEVATION (FT)	0.
SOUND SPEED HVR (FPS)	1117.
*STD DAY TEMP (DEG F)	59.
*EMERG HOVER ALT (FT)	2000.
*HOT DAY TEMP (DEG F)	95.
*CT/SIG MAX	0.150
*MAX ACCELERATION (G)	0.25
*DESIGN CRUISE (MPH)	400.
*CRUISE ALTITUDE (FT)	15000.
SOUND SPEED CRSE (FPS)	1058.
*MAX DECELERATION (G)	0.20
*STRUCT LOAD FACTOR	4.5
*FLIGHT CREW	2.
*CABIN CREW	1.
*ATC SPEED LIMIT	YES

DESIGN MISSION	SPEED MPH	HEIGHT FT	DIST MI	TIME MIN	FUEL LB
TAKEOFF & LANDING				2.00	63.
ACCEL. & CONV.		1500.	1.6	1.30	52.
AIRPLANE CLIMB	145.,178.	13500.	11.1	4.13	162.
ACCEL. TO CRUISE			12.0	2.20	92.
CRUISE	401.		438.7	65.72	2316.
AIRPLANE DESCENT	400.,301.	12000.	26.7	4.69	22.
APPROACH		3000.	10.0	3.99	24.
TOTAL			500.0	84.02	2732.
RESERVE				20.00	634.

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TILT ROTOR DESIGN PROGRAM 1974

S-80-20                                                                      DESIGN ITERATIONS:  3

OVERALL                                  POWERPLANT                                FUSELAGE                            STRUCT TECHNOLOGY FACTORS
  GROSS WEIGHT (LB)        23732.    INST NORMAL PWR (HP)          3516.    *LENGTH (FT)                55.0    *ROTOR                        1.00
  EMPTY WEIGHT (LB)        17947.   *NUMBER OF ENGINES               2.    *DIAMETER (FT)               8.5    *TRANSMISSION                 0.83
  FUEL WEIGHT (LB)          1785.   *EXCESS FACTOR HEL MODE        1.45    *DRAG FACTOR                 1.00    *AIRFRAME                     0.78
  PAYLOAD (LB)              4000.   *% RATED EMRG HVR              140.                                         *ENGINE (HP/LB)               7.00
  CRUISE SPEED (MPH)         311.   *          CONV + CLIMB        120.   FLAT PLATE AREAS (SF)                 *ENGINE INSTALLATION          2.55
  L/D CRUISE               12.12    *          CRUISE               90.    WING PROFILE                3.23
 *RANGE (STAT MI)            500.    INST PWR EMRG HVR (HP)        3391.    FUSELAGE                    3.51   DESIGN MISSION
 *PASSENGER SEATS             20.                 CONVER  (HP)     2648.    EMPENNAGE                   1.94    *FIELD ELEVATION (FT)           0.
 *CARGO (LB)                   0.                 CRUISE  (HP)     3516.    TOTAL PROFILE              10.50     SOUND SPEED HVR   (FPS)   1117.
                                    *SFC (LB/HP HR)               0.400     WING INDUCED                2.09    *STD DAY TEMP (DEG F)          59.
ROTORS                                                                                                          *EMERG HOVER ALT (FT)        2000.
 *DISC LOADING (PSF)        5.50  DRIVE SYSTEM                            COMPONENT WEIGHTS (LB)                *HOT DAY TEMP (DEG F)          95.
  RADIUS (FT)               26.2    *EFFICIENCY                    0.97     ROTORS                     2849.    *CT/SIG MAX                  0.150
  SOLIDITY                 0.174     HEL MODE WEIGHT (LB)          3040.    DRIVE SYSTEM               3259.    *MAX ACCELERATION (G)        0.25
  BLADE CHORD (FT)          2.38     AIRPLANE WEIGHT (LB)          3259.    POWERPLANT                 1281.    *DESIGN CRUISE (MPH)          310.
  TOTAL BLADES                12                                            NACELLES                    131.    *CRUISE ALTITUDE (FT)       15000.
 *CT/SIG HOVER             0.120  WING                                      FUEL SYSTEM                  82.     SOUND SPEED CRSE (FPS)     1058.
 *PROFILE DRAG COEFF       0.010     AREA (SF)                      456.    WING                       2081.    *MAX DECELERATION (G)        0.20
  % DOWNLOAD                 8.7    *LOADING (PSF)                 52.0     FUSELAGE                   2777.    *STRUCT LOAD FACTOR           4.5
 *EFFICIENCY HOVER          0.85     ASPECT RATIO                  8.67     EMPENNAGE                   463.    *FLIGHT CREW                    2.
 *           CONVER         0.83     SPAN (FT)                     52.9     LANDING GEAR                712.    *CABIN CREW                     0.
             CRUISE         0.66     MEAN CHORD (FT)               7.25     FLIGHT CONTROLS             786.    *ATC SPEED LIMIT              YES
  HEL MODE WEIGHT (LB)      2768.   *THICKNESS/CHORD RATIO        0.210     HYDRAULICS                  199.
  AIRPLANE WEIGHT (LB)      2849.   *TAPER RATIO                   0.70     ELECTRICAL                  289.
 *TIP SPEED HOVER            380.    SWEEP (DEG)                   -5.2     INSTR+AVIONICS              580.
 *          CRUISE           383.    CRUISE LIFT COEFF             0.33     AIR CONDITIONING            760.
 *FUSELAGE CLEARNCE (FT)     1.0     MAX LIFT COEFF CONVER         1.99     FURNISHINGS                1300.
 *MAX HEL MODE ADV RATIO    0.40    *MAX LIFT COEFF CLEAN          1.40     FLUIDS                      119.
                                    *FLAP AREA/WING AREA           0.25     FLIGHT CREW                 400.
 * INDICATES INPUT VARIABLE          CLIMB SPD/CONVER SPD          1.23     CABIN CREW                    0.

DESIGN MISSION              SPEED      HEIGHT   DIST     TIME     FUEL
                             MPH         FT      MI       MIN      LB
  TAKEOFF & LANDING                                       2.00     31.
  ACCEL. & CONV.                       1500.     1.4      1.32     27.
  AIRPLANE CLIMB          128..157.   13500.    11.2      4.73     89.
  ACCEL. TO CRUISE                               4.3      1.04     21.
  CRUISE                     311.              443.5     85.68   1278.
  AIRPLANE DESCENT        311..258.   12000.    29.9      6.34     14.
  APPROACH                             3000.     9.7      4.52     13.

   TOTAL                                       500.0    105.63   1473.

   RESERVE                                               20.00    312.
```

TILT ROTOR DESIGN PROGRAM 1974

S-80-50 DESIGN ITERATIONS: 4

OVERALL		POWERPLANT		FUSELAGE		STRUCT TECHNOLOGY FACTORS	
GROSS WEIGHT (LB)	53475.	INST NORMAL PWR (HP)	7649.	*LENGTH (FT)	80.0	*ROTOR	1.00
EMPTY WEIGHT (LB)	39534.	*NUMBER OF ENGINES	2.	*DIAMETER (FT)	10.0	*TRANSMISSION	0.83
FUEL WEIGHT (LB)	3795.	*EXCESS FACTOR HEL MODE	1.45	*DRAG FACTOR	1.00	*AIRFRAME	0.78
PAYLOAD (LB)	10150.	*% RATED EMRG HVR	140.			*ENGINE (HP/LB)	8.50
CRUISE SPEED (MPH)	323.	* CONV + CLIMB	120.	FLAT PLATE AREAS (SF)		*ENGINE INSTALLATION	1.50
L/D CRUISE	13.15	* CRUISE	90.	WING PROFILE	6.83		
*RANGE (STAT MI)	500.	INST PWR EMRG HVR (HP)	7645.	FUSELAGE	5.50	DESIGN MISSION	
*PASSENGER SEATS	50.	CONVER (HP)	5573.	EMPENNAGE	4.10	*FIELD ELEVATION (FT)	0.
*CARGO (LB)	0.	CRUISE (HP)	6989.	TOTAL PROFILE	19.89	SOUND SPEED HVR (FPS)	1117.
		*SFC (LB/HP HR)	0.460	WING INDUCED	4.41	*STD DAY TEMP (DEG F)	59.
ROTORS						*EMERG HOVER ALT (FT)	2000.
*DISC LOADING (PSF)	5.50	DRIVE SYSTEM		COMPONENT WEIGHTS (LB)		*HOT DAY TEMP (DEG F)	95.
RADIUS (FT)	35.3	*EFFICIENCY	0.97	ROTORS	6842.	*CT/SIG MAX	0.150
SOLIDITY	0.174	HEL MODE WEIGHT (LB)	8067.	DRIVE SYSTEM	8432.	*MAX ACCELERATION (G)	0.25
BLADE CHORD (FT)	3.58	AIRPLANE WEIGHT (LB)	8432.	POWERPLANT	1350.	*DESIGN CRUISE (MPH)	310.
TOTAL BLADES	12			NACELLES	148.	*CRUISE ALTITUDE (FT)	15000.
*CT/SIG HOVER	0.120	WING		FUEL SYSTEM	295.	SOUND SPEED CRSE (FPS)	1056.
*PROFILE DRAG COEFF	0.011	AREA (SF)	1125.	WING	5550.	*MAX DECELERATION (G)	0.20
% DOWNLOAD	5.1	*LOADING (PSF)	52.0	FUSELAGE	5730.	*STRUCT LOAD FACTOR	4.5
*EFFICIENCY HOVER	0.85	ASPECT RATIO	7.59	EMPENNAGE	1343.	*FLIGHT CREW	2.
* CONVER	0.83	SPAN (FT)	90.7	LANDING GEAR	1605.	*CABIN CREW	1.
CRUISE	0.66	MEAN CHORD (FT)	11.34	FLIGHT CONTROLS	2476.	*ATC SPEED LIMIT	YES
HEL MODE WEIGHT (LB)	6716.	*THICKNESS/CHORD RATIO	0.210	HYDRAULICS	299.		
AIRPLANE WEIGHT (LB)	6842.	*TAPER RATIO	0.70	ELECTRICAL	512.		
*TIP SPEED HOVER	380.	SWEEP (DEG)	-5.3	INSTR+AVIONICS	703.		
* CRUISE	360.	CRUISE LIFT COEFF	0.31	AIR CONDITIONING	1150.		
*FUSELAGE CLEARNCE (FT)	1.0	MAX LIFT COEFF CONVER	1.98	FURNISHINGS	2500.		
*MAX HEL MODE ADV RATIO	0.40	*MAX LIFT COEFF CLEAN	1.42	FLUIDS	267.		
		*FLAP AREA/WING AREA	0.25	FLIGHT CREW	400.		
* INDICATES INPUT VARIABLE		CLIMB SPD/CONVER SPD	1.32	CABIN CREW	150.		

DESIGN MISSION	SPEED MPH	HEIGHT FT	DIST MI	TIME MIN	FUEL LB
TAKEOFF & LANDING				2.00	70.
ACCEL. & CONV.		1500.	1.6	1.41	64.
AIRPLANE CLIMB	136.,166.	13500.	12.5	4.96	203.
ACCEL. TO CRUISE			5.1	1.17	51.
CRUISE	323.		438.2	81.36	2648.
AIRPLANE DESCENT	323.,268.	12000.	32.6	6.65	32.
APPROACH		340.	10.0	4.48	29.
TOTAL			500.0	102.02	3097.
RESERVE				20.00	698.

... ITERATIONS IS 0.17615E+01

TILT ROTOR DESIGN PROGRAM 1974

S-80-80

DESIGN ITERATIONS: 12

OVERALL		POWERPLANT		FUSELAGE		STRUCT TECHNOLOGY FACTORS	
GROSS WEIGHT (LB)	112274.	INST NORMAL PWR (HP)	16067.	*LENGTH (FT)	95.0	*ROTOR	1.00
EMPTY WEIGHT (LB)	88319.	*NUMBER OF ENGINES	2.	*DIAMETER (FT)	11.5	*TRANSMISSION	0.83
FUEL WEIGHT (LB)	7655.	*EXCESS FACTOR HEL MODE	1.45	*DRAG FACTOR	1.00	*AIRFRAME	0.78
PAYLOAD (LB)	16300.	*% RATED EMRG HVR	140.			*ENGINE (HP/LB)	8.50
CRUISE SPEED (MPH)	340.	* CONV + CLIMB	120.	FLAT PLATE AREAS (SF)		*ENGINE INSTALLATION	2.55
L/D CRUISE	13.55	* CRUISE	90.	WING PROFILE	13.55		
*RANGE (STAT MI)	500.	INST PWR EMRG HVR (HP)	16067.	FUSELAGE	7.[illegible]0	DESIGN MISSION	
*PASSENGER SEATS	80.	CONVER (HP)	12546.	EMPENNAGE	8.13	*FIELD ELEVATION (FT)	0.
*CARGO (LB)	0.	CRUISE (HP)	13002.	TOTAL PROFILE	35.06	SOUND SPEED HVR (FPS)	1117.
		*SFC (LB/HP HR)	0.400	WING INDUCED	7.82	*STD DAY TEMP (DEG F)	59.
ROTORS						*EMERG HOVER ALT (FT)	2000.
*DISC LOADING (PSF)	5.50	DRIVE SYSTEM		COMPONENT WEIGHTS (LB)		*HOT DAY TEMP (DEG F)	95.
RADIUS (FT)	57.0	*EFFICIENCY	0.97	ROTORS	21079.	*CT/SIG MAX	0.150
SOLIDITY	0.174	HEL MODE WEIGHT (LB)	19651.	DRIVE SYSTEM	20624.	*MAX ACCELERATION (G)	0.25
BLADE CHORD (FT)	5.20	AIRPLANE WEIGHT (LB)	20624.	POWERPLANT	4820.	*DESIGN CRUISE (MPH)	310.
TOTAL BLADES	12			NACELLES	3911.	*CRUISE ALTITUDE (FT)	15000.
*CT/SIG HOVER	0.120	WING		FUEL SYSTEM	994.	SOUND SPEED CRSE (FPS)	1058.
*PROFILE DRAG COEFF	0.010	AREA (SF)	2159.	WING	7122.	*MAX DECELERATION (G)	0.20
% DOWNLOAD	5.4	*LOADING (PSF)	52.0	FUSELAGE	8583.	*STRUCT LOAD FACTOR	4.5
*EFFICIENCY HOVER	0.85	ASPECT RATIO	7.53	EMPENNAGE	2189.	*FLIGHT CREW	2.
* CONVER	0.83	SPAN (FT)	127.5	LANDING GEAR	3369.	*CABIN CREW	2.
CRUISE	0.65	MEAN CHORD (FT)	16.93	FLIGHT CONTROLS	7027.	*ATC SPEED LIMIT	YES
HEL MODE WEIGHT (LB)	15075.	*THICKNESS/CHORD RATIO	0.210	HYDRAULICS	434.		
AIRPLANE WEIGHT (LB)	15364.	*TAPER RATIO	0.70	ELECTRICAL	2606.		
*TIP SPEED HOVER	380.	SWEEP (DEG)	-5.4	INSTR+AVIONICS	826.		
* CRUISE	380.	CRUISE LIFT COEFF	0.28	AIR CONDITIONING	1543.		
*FUSELAGE CLEARANCE (FT)	1.0	MAX LIFT COEFF CONVER	1.58	FURNISHINGS	3700.		
*MAX HEL MODE ADV RATIO	0.40	*MAX LIFT COEFF CLEAN	1.43	FLUIDS	561.		
		*FLAP AREA/WING AREA	0.25	FLIGHT CREW	400.		
* INDICATES INPUT VARIABLE		CLIMB SPD/CONVER SPD	1.40	CABIN CREW	3[illegible]2.		

DESIGN MISSION	SPEED MPH	HEIGHT FT	DIST MI	TIME MIN	FUEL LB
TAKEOFF & LANDING				2.00	147.
ACCEL. & CONV.		1500.	1.4	1.17	112.
AIRPLANE CLIMB	145.,175.	13500.	13.2	4.54	427.
ACCEL. TO CRUISE			5.7	1.26	115.
CRUISE	340.		435.0	76.75	5264.
AIRPLANE DESCENT	340.,262.	12000.	34.9	6.77	67.
APPROACH		3000.	5.7	4.13	56.
TOTAL			500.0	97.05	6188.
RESERVE				20.00	1467.

TILT ROTOR DESIGN PROGRAM 1974

S-75-50

DESIGN ITERATIONS: 6

OVERALL	
GROSS WEIGHT (LB)	64347.
EMPTY WEIGHT (LB)	49418.
FUEL WEIGHT (LB)	4778.
PAYLOAD (LB)	10150.
CRUISE SPEED (MPH)	334.
L/D CRUISE	13.33
*RANGE (STAT MI)	500.
*PASSENGER SEATS	50.
*CARGO (LB)	0.

ROTORS	
*DISC LOADING (PSF)	5.50
RADIUS (FT)	43.1
SOLIDITY	0.174
BLADE CHORD (FT)	3.93
TOTAL BLADES	12
*CT/SIG HOVER	0.120
*PROFILE DRAG COEFF	0.010
% DOWNLOAD	9.2
*EFFICIENCY HOVER	0.83
* CONVER	0.81
CRUISE	0.66
HEL MODE WEIGHT (LB)	8695.
AIRPLANE WEIGHT (LB)	8865.
*TIP SPEED HOVER	380.
* CRUISE	380.
*FUSELAGE CLEARANCE (FT)	1.0
*MAX HEL MODE ADV RATIO	0.40

POWERPLANT	
INST NORMAL PWR (HP)	9426.
*NUMBER OF ENGINES	2.
*EXCESS FACTOR HEL MODE	1.45
*% RATED EMRG HVR	140.
* CONV + CLIMB	120.
* CRUISE	90.
INST PWR EMRG HVR (HP)	9426.
CONVER (HP)	7360.
CRUISE (HP)	8008.
*SFC (LB/HP HR)	0.420

DRIVE SYSTEM	
*EFFICIENCY	0.97
HEL MODE WEIGHT (LB)	10513.
AIRPLANE WEIGHT (LB)	11006.

WING	
AREA (SF)	1237.
*LOADING (PSF)	52.0
ASPECT RATIO	7.81
SPAN (FT)	98.3
MEAN CHORD (FT)	12.59
*THICKNESS/CHORD RATIO	0.210
*TAPER RATIO	0.70
SWEEP (DEG)	-5.3
CRUISE LIFT COEFF	0.29
MAX LIFT COEFF CONVER	1.98
*MAX LIFT COEFF CLEAN	1.40
*FLAP AREA/WING AREA	0.25
CLIMB SPD/CONVER SPD	1.35

FUSELAGE	
*LENGTH (FT)	80.0
*DIAMETER (FT)	10.0
*DRAG FACTOR	1.00

FLAT PLATE AREAS (SF)	
WING PROFILE	8.10
FUSELAGE	5.50
EMPENNAGE	4.86
TOTAL PROFILE	22.34
WING INDUCED	4.82

COMPONENT WEIGHTS (LB)	
ROTORS	8865.
DRIVE SYSTEM	11006.
POWERPLANT	3434.
NACELLES	1385.
FUEL SYSTEM	443.
WING	5555.
FUSELAGE	6043.
EMPENNAGE	1287.
LANDING GEAR	1930.
FLIGHT CONTROLS	3205.
HYDRAULICS	328.
ELECTRICAL	1185.
INSTR+AVIONICS	703.
AIR CONDITIONING	1150.
FURNISHINGS	2500.
FLUIDS	322.
FLIGHT CREW	400.
CABIN CREW	150.

STRUCT TECHNOLOGY FACTORS	
*ROTOR	1.05
*TRANSMISSION	0.85
*AIRFRAME	0.80
*ENGINE (HP/LB)	7.00
*ENGINE INSTALLATION	2.55

DESIGN MISSION	
*FIELD ELEVATION (FT)	0.
SOUND SPEED HVR (FPS)	1117.
*STD DAY TEMP (DEG F)	59.
*EMERG HOVER ALT (FT)	2000.
*HOT DAY TEMP (DEG F)	95.
*CT/SIG MAX	0.150
*MAX ACCELERATION (G)	0.25
*DESIGN CRUISE (MPH)	310.
*CRUISE ALTITUDE (FT)	13000.
SOUND SPEED CRSE (FPS)	1058.
*MAX DECELERATION (G)	0.20
*STRUCT LOAD FACTOR	4.5
*FLIGHT CREW	2.
*CABIN CREW	1.
*ATC SPEED LIMIT	YES

* INDICATES INPUT VARIABLE

DESIGN MISSION	SPEED MPH	HEIGHT FT	DIST MI	TIME MIN	FUEL LB
TAKEOFF & LANDING				2.00	90.
ACCEL. & CONV.		1500.	1.4	1.21	72.
AIRPLANE CLIMB	140.,172.	13500.	12.8	4.96	263.
ACCEL. TO CRUISE			5.7	1.27	71.
CRUISE	334.		437.1	78.46	3303.
AIRPLANE DESCENT	334.,277.	12000.	33.2	6.56	40.
APPROACH		3000.	9.7	4.20	35.
TOTAL			500.0	98.64	3875.
RESERVE				20.00	904.

TILT ROTOR DESIGN PROGRAM 1974

S-85-50 DESIGN ITERATIONS: 5

OVERALL	
GROSS WEIGHT (LB)	51417.
EMPTY WEIGHT (LB)	37845.
FUEL WEIGHT (LB)	3422.
PAYLOAD (LB)	10150.
CRUISE SPEED (MPH)	318.
L/D CRUISE	13.23
*RANGE (STAT MI)	500.
*PASSENGER SEATS	50.
*CARGO (LB)	0.

ROTORS	
*DISC LOADING (PSF)	5.50
RADIUS (FT)	38.6
SOLIDITY	0.174
BLADE CHORD (FT)	3.51
TOTAL BLADES	12
*CT/SIG HOVER	0.120
*PROFILE DRAG COEFF	0.010
% DOWNLOAD	9.0
*EFFICIENCY HOVER	0.87
* CONVER	0.85
CRUISE	0.66
HEL MODE WEIGHT (LB)	6064.
AIRPLANE WEIGHT (LB)	6177.
*TIP SPEED HOVER	380.
* CRUISE	380.
*FUSELAGE CLEARNCE (FT)	1.0
*MAX HEL MODE ADV RATIO	0.40

POWERPLANT	
INST NORMAL PWR (HP)	7184.
*NUMBER OF ENGINES	2.
*EXCESS FACTOR HEL MODE	1.45
*% RATED EMRG HVR	140.
* CONV + CLIMB	120.
* CRUISE	90.
INST PWR EMRG HVR (HP)	7184.
CONVER (HP)	5610.
CRUISE (HP)	6795.
*SFC (LB/HP HR)	0.380

DRIVE SYSTEM	
*EFFICIENCY	0.97
HEL MODE WEIGHT (LB)	7371.
AIRPLANE WEIGHT (LB)	7702.

WING	
AREA (SF)	989.
*LOADING (PSF)	52.0
ASPECT RATIO	8.04
SPAN (FT)	89.1
MEAN CHORD (FT)	11.09
*THICKNESS/CHORD RATIO	0.210
*TAPER RATIO	0.70
SWEEP (DEG)	-5.3
CRUISE LIFT COEFF	0.32
MAX LIFT COEFF CONVER	1.98
*MAX LIFT COEFF CLEAN	1.40
*FLAP AREA/WING AREA	0.25
CLIMB SPD/CONVER SPD	1.31

FUSELAGE	
*LENGTH (FT)	80.0
*DIAMETER (FT)	10.0
*DRAG FACTOR	1.00

FLAT PLATE AREAS (SF)	
WING PROFILE	6.59
FUSELAGE	5.50
EMPENNAGE	3.96
TOTAL PROFILE	19.42
WING INDUCED	4.46

COMPONENT WEIGHTS (LB)	
ROTORS	6177.
DRIVE SYSTEM	7702.
POWERPLANT	1832.
NACELLES	29[illegible].
FUEL SYSTEM	250.
WING	5271.
FUSELAGE	5551.
EMPENNAGE	977.
LANDING GEAR	1543.
FLIGHT CONTROLS	2337.
HYDRAULICS	293.
ELECTRICAL	863.
INSTR+AVIONICS	703.
AIR CONDITIONING	1150.
FURNISHINGS	2500.
FLUIDS	257.
FLIGHT CREW	400.
CABIN CREW	150.

STRUCT TECHNOLOGY FACTORS	
*ROTOR	0.95
*TRANSMISSION	0.81
*AIRFRAME	0.76
*ENGINE (HP/LB)	10.00
*ENGINE INSTALLATION	2.55

DESIGN MISSION	
*FIELD ELEVATION (FT)	0.
SOUND SPEED HVR (FPS)	1117.
*STD DAY TEMP (DEG F)	59.
*EMERG HOVER ALT (FT)	2000.
*HOT DAY TEMP (DEG F)	95.
*CT/SIG MAX	0.150
*MAX ACCELERATION (G)	0.25
*DESIGN CRUISE (MPH)	310.
*CRUISE ALTITUDE (FT)	15000.
SOUND SPEED CRSE (FPS)	1058.
*MAX DECELERATION (G)	0.20
*STRUCT LOAD FACTOR	4.5
*FLIGHT CREW	2.
*CABIN CREW	1.
*ATC SPEED LIMIT	YES

* INDICATES INPUT VARIABLE

DESIGN MISSION	SPEED MPH	HEIGHT FT	DIST MI	TIME MIN	FUEL LB
TAKEOFF & LANDING				2.00	62.
ACCEL. & CONV.		1500.	1.4	1.25	51.
AIRPLANE CLIMB	136.-167.	13500.	12.5	4.96	181.
ACCEL. TO CRUISE			4.7	1.09	43.
CRUISE	318.		439.0	82.81	2408.
AIRPLANE DESCENT	318.-264.	12000.	32.7	6.78	29.
APPROACH		3000.	9.7	4.41	25.
TOTAL			500.0	103.30	2799.
RESERVE				20.00	623.

Appendix 2: Noise Maps for Basic Variation Aircraft

C-EC-5C

STAGE LENGTH (MI.)	25.	50.	75.	100.	150.	200.	300.	400.	500.
CRUISE ALTITUDE (FT.)	2000.	4000.	11000.	12500.	15000.	15000.	15000.	15000.	15000.
CRUISE SPEED (MPH)	296.	365.	440.	444.	446.	446.	446.	446.	446.
CRUISE L/D	12.51	12.51	9.73	9.26	9.76	9.78	9.78	9.78	9.78
CRUISE DISTANCE (MI.)	10.8	31.4	22.3	41.1	83.4	133.4	233.4	333.4	433.4
BLOCK TIME (MIN.)	10.0	15.0	19.5	22.2	29.3	36.[illegible]	45.5	62.9	76.4
BLOCK FUEL (LB.)	289.	440.	632.	795.	1146.	1495.	2195.	2864.	3531.
BLOCK SPEED (MPH)	151.	199.	243.	270.	307.	333.	364.	381.	393.

DIRECT OPERATING COST - ANN UTILIZATION(HR)=2[illegible]. DEPRECIATION PERIOD(YR)=10. LABOR RATE($/HR)= 7.0
AIRFRAME COST ($/LB)= 80.0 ENGINE COST ($/HP)= 60.0 INSURANCE RATE=0.040 FUEL COST (CENTS/GAL)= 18.0
DOC=1.90+0.0250*SL $/SEAT-TRIP (SL= 25.,500.)
HCP LENGTHS 50+150+ 0+ 0+ 0=200 100+200+ 0+ 0+ 0=300 200+200+ 0+ 0+ 0=400

STAGE LENGTH	25.	50.	75.	100.	150.	200.	300.	400.	500.	200.	300.	400.
NO. CYCLES/STARTS	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	2/1	2/1	2/1
FLIGHT CREW	0.642	0.464	0.357	0.358	0.315	0.29[illegible]	0.266	0.253	0.246	0.373	0.323	0.298
FUEL & OIL	0.322	0.245	0.234	0.221	0.212	0.203	0.202	0.199	0.196	0.220	0.212	0.208
FULL INSURANCE	0.360	0.272	0.223	0.201	0.177	0.143	0.159	0.142	0.138	0.201	0.176	0.163
TOTAL FLIGHT OPS	1.324	1.001	0.854	0.780	0.704	0.661	0.617	0.595	0.580	0.794	0.711	0.665
LABOR AIRFRAME	0.512	0.330	0.254	0.217	0.180	0.159	0.1[illegible]	0.129	0.123	0.215	0.177	0.158
MATERIAL AIRFRAME	0.196	0.119	0.089	0.074	0.059	0.0[illegible]2	[illegible]	[illegible]	0.037	0.072	0.057	0.050
LABOR ENGINES	0.329	0.180	0.128	0.101	0.075	0.062	0.048	0.041	0.037	0.092	0.069	0.057
MATERIAL ENGINES	0.551	0.296	0.217	0.163	0.116	[illegible]	0.[illegible]73	0.062	0.055	0.144	0.136	0.066
MAT. BURDEN	1.093	0.664	0.496	0.415	0.331	0.287	0.243	0.221	0.233	0.399	0.320	0.280
TOTAL MAINTENANCE	2.681	1.589	1.173	0.971	0.763	0.655	0.547	0.493	0.461	0.923	0.729	0.631
DEPRECIATION	1.[illegible]49	1.792	0.849	0.585	0.515	0.474	0.434	0.414	0.402	0.584	0.511	0.474
TOTAL DIRECT OPERATING COST												
$/AIRCRAFT MILE	5.154	3.383	2.676	2.335	1.982	1.79[illegible]	1.598	1.531	1.443	2.301	1.951	1.775
$/FLIGHT HOUR	780.8	674.8	651.2	630.7	606.4	595.1	581.3	572.5	566.6	622.5	602.9	590.9
$/SEAT MILE	0.1011	0.0677	0.0535	0.0467	0.0396	0.0358	0.0320	0.0300	0.0289	0.0460	0.0390	0.0355
$/SEAT-TRIP	2.53	3.36	4.01	4.67	5.95	7.16	9.59	12.01	14.43	9.20	11.71	14.20

DEPARTURE

TIME HISTORY AT 500 FT SIDELINE
TIME= 1.5 4.5 7.5 10.5 13.5 16.5 19.5 22.5 25.5 28.5 31.5 34.5 37.5 40.5 43.5 46.5 49.5 52.5 55.5 58.5
61.5 64.5 67.5 70.5
PNL = 100.6 101.1 101.5 102.9 104.3 105.0 104.7 103.2 101.1 98.5 95.7 92.5 89.5 86.7 82.1 79.5 77.5 75.7 74.0 72.4

ARRIVAL

TIME HISTORY AT 500 FT SIDELINE
TIME= 298.5 301.5 304.5 307.5 310.6 313.5 316.5 319.5 322.5 [illegible] [illegible] 331.5 334.5 [illegible] [illegible] 343.5
358.5 361.5 364.5 367.5 370.5 373.5 376.5 379.5 382.5 385.5 [illegible] 391.5 394.5 397.5 [illegible]
PNL = 78.7 77.3 75.5 72.6 69.9 70.8 72.2 73.0 74.1 75.3 75.7 74.5 72.7 [illegible] [illegible] [illegible]
76.0 76.3 76.9 77.4 77.9 78.4 79.0 79.5 80.1 80.7 81.3 82.[illegible] [illegible] [illegible] 84.2 [illegible]

C-EC-SC

DEPARTURE PATH TO 10,000 FT MSL

MAX FUSE ANGLE=20. OBSTACLE CLEAR ANGLE=60. OBSTACLE HEIGHT=100. MAX ACCEL ROTATION RATE=20. ACCEL BUILDUP TIME= 5.

TIME SEC	DIST FT	ALT FT	VEL FPS	ACC G	GAM DEG	THRUST LB	LWGC LB	LWGI LB	CWGC LB	CWGI LB	DFUST LB	ALP DEG	THE DEG	AWT DEG	ALV DEG	LAMDA	MU	CT	POWER HP
OBSTACLE CLEARANCE																			
0.0	0.	0.	0.	0.0	60.0	44193.	0.	-59.	0.	1298.	0.	30.1	2.9	-57.1	30.5	0.0662	0.0	0.0088	6312.
8.6	11.	19.	5.	0.036	60.0	44580.	-1.	-571.	1.	718.	4.	29.7	24.6	-35.4	28.2	0.0698	0.0031	0.0090	6757.
10.5	18.	31.	10.	0.124	60.0	48275.	-6.	-666.	3.	664.	18.	27.5	24.6	-35.4	25.0	0.0752	0.0057	0.0097	7652.
11.6	25.	43.	15.	0.153	60.0	49417.	-13.	-696.	6.	648.	40.	26.9	24.6	-35.4	24.0	0.0786	0.0087	0.0099	8076.
12.8	35.	61.	21.	0.117	60.0	48025.	-23.	-704.	11.	581.	71.	27.7	24.6	-35.4	22.2	0.0809	0.0113	0.0096	8076.
14.3	53.	91.	25.	0.084	60.0	46813.	-36.	-702.	13.	559.	111.	28.5	24.6	-35.4	21.7	0.0830	0.0145	0.0093	8076.
14.7	58.	100.	26.	0.049	60.0	45540.	-52.	-700.	26.	534.	159.	29.3	24.6	-35.4	21.0	0.0853	0.0179	0.0091	8076.
ACCELERATION AND CONVERSION																			
17.0	97.	158.	34.	0.195	52.2	44318.	-80.	-937.	25.	307.	137.	27.8	24.6	-27.6	20.4	0.0883	0.0204	0.0093	8076.
18.5	135.	199.	40.	0.179	41.8	44288.	-149.	-1261.	25.	211.	100.	39.6	24.6	-17.2	26.0	0.0883	0.0316	0.0093	8076.
20.1	191.	243.	48.	0.176	34.4	44453.	-200.	-1539.	26.	169.	72.	47.4	24.6	-9.8	29.0	0.0879	0.0432	0.0093	8076.
21.7	262.	287.	55.	0.180	29.0	44525.	9.	-1774.	23.	148.	53.	52.6	24.6	-4.4	29.6	0.0877	0.0544	0.0093	8076.
23.3	345.	329.	64.	0.184	24.9	44570.	285.	-1993.	28.	135.	43.	56.3	24.6	-0.4	28.8	0.0875	0.0656	0.0093	8076.
24.8	439.	370.	72.	0.194	21.9	44626.	635.	-2218.	40.	137.	43.	58.6	24.6	2.7	27.3	0.0873	0.0766	0.0093	8076.
26.3	544.	409.	81.	0.196	19.4	44580.	1060.	-2454.	61.	140.	51.	60.7	24.6	5.2	25.4	0.0873	0.0877	0.0093	8076.
27.8	662.	448.	89.	0.196	17.5	44473.	1563.	-2712.	89.	147.	69.	62.4	24.6	7.1	23.3	0.0874	0.0988	0.0093	8076.
29.2	794.	488.	98.	0.193	15.8	44307.	2146.	-3000.	125.	156.	90.	63.8	24.6	8.7	21.2	0.0876	0.1099	0.0093	8076.
30.8	948.	530.	107.	0.175	14.5	43280.	2838.	-2433.	165.	116.	131.	64.9	24.6	10.1	18.6	0.0895	0.1201	0.0090	8076.
32.3	1118.	572.	116.	0.191	13.4	41946.	3550.	-118.	219.	73.	176.	63.3	24.6	11.2	16.2	0.0922	0.1300	0.0088	8076.
33.9	1297.	613.	125.	0.184	12.4	40204.	4373.	144.	279.	61.	230.	62.7	24.6	12.2	13.9	0.0961	0.1392	0.0084	8076.
35.4	1495.	655.	134.	0.181	11.5	38351.	5277.	1526.	345.	91.	293.	61.5	24.6	13.0	11.9	0.1036	0.1443	0.0080	8076.
37.1	1715.	698.	143.	0.172	10.8	36485.	6151.	2797.	407.	120.	353.	60.8	24.3	13.5	10.1	0.1055	0.1572	0.0076	8076.
38.9	1976.	746.	152.	0.146	10.2	34606.	6916.	3179.	452.	165.	399.	61.3	23.7	13.5	8.6	0.1117	0.1661	0.0072	8076.
40.8	2273.	798.	161.	0.151	9.6	33154.	7737.	4909.	500.	214.	449.	59.6	23.1	13.5	7.5	0.1156	0.1755	0.0069	8076.
42.8	2597.	851.	170.	0.137	9.1	31245.	8554.	6065.	551.	276.	500.	59.0	22.6	13.5	6.4	0.1225	0.1837	0.0065	8076.
45.0	2975.	910.	179.	0.124	8.6	29255.	9445.	7326.	604.	347.	555.	58.0	22.1	13.5	5.4	0.1305	0.1912	0.0061	8076.
47.3	3410.	974.	189.	0.115	8.2	27234.	10382.	8620.	660.	425.	613.	56.3	21.7	13.5	4.5	0.1399	0.1979	0.0057	8076.
49.9	3905.	1043.	198.	0.106	7.8	25143.	11363.	9992.	718.	511.	673.	54.3	21.3	13.5	3.8	0.1514	0.2029	0.0053	8076.
52.8	4472.	1119.	207.	0.097	7.5	22974.	12390.	11433.	779.	605.	737.	51.6	21.0	13.5	3.1	0.1656	0.2058	0.0048	8076.
55.9	5139.	1205.	216.	0.083	7.1	20575.	13463.	12992.	843.	711.	803.	48.7	20.6	13.5	2.4	0.1950	0.2037	0.0043	8076.
59.5	5916.	1300.	225.	0.078	6.8	18378.	1458..	14583.	909.	820.	873.	44.1	20.3	13.5	1.9	0.2075	0.1971	0.0038	8076.
63.2	6761.	1399.	234.	0.076	6.6	16253.	15742.	16250.	978.	937.	945.	37.8	20.1	13.5	1.3	0.2355	0.1814	0.0034	8076.
66.9	7640.	1499.	243.	0.078	6.3	14344.	16950.	17565.	1049.	1060.	1021.	29.4	19.8	13.5	0.9	0.2687	0.1516	0.0030	8076.
70.4	8515.	1594.	253.	0.083	6.1	12874.	18203.	19793.	1123.	1150.	1099.	18.5	19.6	13.5	0.5	0.3030	0.1019	0.0027	8076.
71.7	8838.	1628.	256.	0.084	6.0	12418.	18681.	20450.	1152.	1236.	1129.	13.9	19.5	13.5	0.4	0.3137	0.0802	0.0026	8076.
AIRPLANE MODE CLIMB TO 10,000 FT																			
87.6	12869.	2135.	256.	0.0	14.3	14092.													
219.3	47918.	10000.	291.	0.0	12.0	12404.													

THE NOISE ANNOYANCE IS 0.8878E20+07 ONE POINT IN 1 OF THE GRID WAS USED

AT 500. FT. SIDELINE AND 0. FT. FORWARD, NOISE=107.6 EPNDB
AT 1000. FT. SIDELINE AND 0. FT. FORWARD, NOISE=102.1 EPNDB
AT 10000. FT. SIDELINE AND 0. FT. FORWARD, NOISE= 77.5 EPNDB
AT 20000. FT. SIDELINE AND 0. FT. FORWARD, NOISE= 58.5 EPNDB
AT 0. FT. SIDELINE AND-20000. FT. FORWARD, NOISE= 68.1 EPNDB
AT 0. FT. SIDELINE AND -5000. FT. FORWARD, NOISE= 85.0 EPNDB
AT 0. FT. SIDELINE AND 6000. FT. FORWARD, NOISE= 95.3 EPNDB
AT 0. FT. SIDELINE AND 30000. FT. FORWARD, NOISE= 74.4 EPNDB
AT 0. FT. SIDELINE AND 51000. FT. FORWARD, NOISE= 0.0 EPNDB
AT 0. FT. SIDELINE AND 2500. FT. FORWARD, NOISE=103.0 EPNDB

ORIGINAL PAGE IS OF POOR QUALITY

C-EC-5C

ARRIVAL PATH FROM 10,000 FT MSL

TERMINAL AREA SPEED = 200. KIAS, FINAL APPROACH SPEED = [illegible] KIAS, FINAL APPROACH SLOPE = 8.0 DEG, ACCEL BUILDUP TIME = 5. SEC

MAX DOWNWARD FUSE ANGLE =10.0 DEG

TIME SEC	DIST FT	ALT FT	VEL FPS	ACC G	GAM DEG	THRUST LB	LWG LB	DWG LB	DNAC LB	DLG LB	DFUST LB	ALP DEG	THE DEG	AWO DEG	ALV DEG	LAMBDA	MU	CT	POWER HP
AIRPLANE MODE DESCENT																			
0.0	0.	10000.	491.	0.0	-4.8	0.													
195.0	90545.	3167.	441.	0.0	-4.8	0.													
204.1	94568.	3000.	441.	0.0	0.0	0.													
AIRPLANE MODE DECELERATION																			
217.3	100276.	3000.	423.	-0.083	0.0	0.													
223.7	102935.	3000.	406.	-0.088	0.0	0.													
229.6	105292.	3000.	388.	-0.097	0.0	0.													
235.0	107337.	3000.	371.	-0.107	0.0	0.													
245.3	111051.	3000.	353.	0.0	0.0	4643.													
AIRPLANE MODE DESCENT																			
260.8	116518.	2612.	353.	0.0	-8.1	0.													
279.0	122805.	1757.	345.	0.0	-8.1	0.													
291.2	126992.	1500.	345.	0.0	0.0	0.													
DECELERATION AND CONVERSION																			
296.6	128755.	1500.	328.	-0.200	0.0	0.						14.1							
299.2	129650.	1500.	311.	-0.200	0.0	2009.	37854.	4390.	1842.	2235.	781.	35.4	3.2	3.2	0.1	0.3169	0.2250	0.0004	2405.
301.5	130459.	1500.	293.	-0.200	0.0	4608.	35485.	4691.	[illegible]	[illegible]	697.	51.2	3.2	3.2	0.3	0.2309	0.2858	0.0010	3322.
304.6	131222.	1500.	276.	-0.200	0.0	7565.	32420.	4878.	3369.	1766.	617.	63.7	3.2	3.2	0.7	0.1553	0.3093	0.0016	3589.
307.3	131938.	1500.	259.	-0.200	0.0	10907.	28857.	4975.	3367.	1552.	543.	73.1	3.2	3.2	1.2	0.0972	0.3057	0.0023	3382.
310.0	132619.	1500.	242.	-0.200	0.0	14575.	25100.	4850.	3101.	1352.	473.	79.9	3.2	3.2	1.9	0.0575	0.2973	0.0031	2946.
312.6	133233.	1500.	224.	-0.200	0.0	18435.	21185.	[illegible]	2733.	1166.	408.	84.7	3.2	3.2	2.8	0.0324	0.2792	0.0039	2460.
315.3	133810.	1500.	207.	-0.200	0.0	22346.	17176.	4336.	2345.	993.	347.	88.2	3.2	3.2	4.0	0.0171	0.2587	0.0047	2016.
318.0	134342.	1500.	190.	-0.200	0.0	26192.	13476.	3857.	1972.	835.	292.	90.8	3.2	3.2	5.6	0.0082	0.2372	0.0055	1663.
320.7	134823.	1500.	173.	-0.204	0.0	29817.	9935.	3348.	1626.	690.	241.	93.2	3.2	3.2	7.7	0.0042	0.2154	0.0062	1449.
323.3	135261.	1500.	155.	-0.197	0.0	33225.	6613.	2681.	1314.	559.	195.	94.5	3.2	3.2	10.5	0.0044	0.1936	0.0069	1449.
326.0	135658.	1500.	138.	-0.199	0.0	36209.	3775.	1908.	1033.	441.	154.	96.3	3.2	3.2	14.6	0.0046	0.1717	0.0075	1449.
328.7	136005.	1500.	121.	-0.200	0.0	37249.	2845.	1486.	786.	338.	118.	97.5	3.2	3.2	19.6	0.0063	0.1497	0.0078	1539.
334.1	136606.	1500.	104.	0.0	0.0	37827.	1931.	1155.	588.	248.	87.	86.4	3.2	3.2	23.7	0.0373	0.1252	0.0079	3639.
HELICOPTER MODE FINAL APPROACH																			
335.6	137069.	1468.	104.	0.0	-8.0	37648.	1851.	1109.	584.	248.	90.	94.9	-5.4	2.6	25.8	0.0191	0.1289	0.0078	2386.
430.8	146425.	153.	101.	0.0	-8.0	37648.	1351.	1109.	534.	249.	90.	94.9	-5.4	2.6	25.8	0.0187	0.1261	0.0075	2405.
DECELERATION TO HOVER																			
436.1	146907.	85.	84.	-0.200	-8.0	40024.	1293.	756.	373.	172.	62.	107.5	-5.4	2.6	42.6	0.0081	0.1007	0.0080	1690.
438.7	147104.	57.	68.	-0.200	-8.0	40767.	688.	676.	240.	110.	40.	107.9	-5.4	2.6	59.4	0.0228	0.0803	0.0081	2768.
441.3	147257.	36.	51.	-0.200	-8.0	41469.	160.	759.	139.	62.	22.	108.2	-5.4	2.6	76.0	0.0384	0.0602	0.0083	3946.
443.9	147367.	20.	34.	-0.200	-8.0	42022.	-189.	960.	68.	28.	10.	108.3	-5.4	2.6	89.0	0.0513	0.0401	0.0084	4951.
446.6	147432.	11.	17.	-0.200	-8.0	42316.	-325.	1036.	26.	7.	2.	108.5	-5.4	2.6	99.4	0.0558	0.0200	0.0084	5624.
451.8	147476.	5.	1.	0.0	-8.0	40549.	-427.	994.	12.	0.	0.	97.9	-5.4	2.6	97.8	0.0635	0.0	0.0081	5708.
LAND																			
456.8	147476.	0.	0.	0.0	-90.0	40559.	35.	-1082.	12.	0.	0.	-180.0	2.9	92.9	180.0	0.0635	0.0	0.0081	5711.

THE NOISE ANNOYANCE IS 0.1111ID+08 ONE POINT IN 1 OF THE GRID WAS USED

AT 500. FT. SIDELINE AND 0. FT. FORWARD, NOISE=105.7 EPNDB
AT 1000. FT. SIDELINE AND 0. FT. FORWARD, NOISE=100.6 EPNDB
AT 10000. FT. SIDELINE AND 0. FT. FORWARD, NOISE= 81.0 EPNDB
AT 20000. FT. SIDELINE AND 0. FT. FORWARD, NOISE= 72.3 EPNDB
AT 0. FT. SIDELINE AND-20000. FT. FORWARD, NOISE= 71.4 EPNDB
AT 0. FT. SIDELINE AND -5110. FT. FORWARD, NOISE= 87.3 EPNDB
AT 0. FT. SIDELINE AND 6010. FT. FORWARD, NOISE=103.7 EPNDB
AT 0. FT. SIDELINE AND 30000. FT. FORWARD, NOISE= 75.7 EPNDB
AT 0. FT. SIDELINE AND 51000. FT. FORWARD, NOISE= 76.0 EPNDB
AT 0. FT. SIDELINE AND 2500. FT. FORWARD, NOISE=108.1 EPNDB

C-80-50 DEPARTURE

93.3	93.2	93.0	92.4	92.0	91.6	91.1	90.6	[illegible]	[illegible]
94.4	94.3	94.0	93.7	93.3	92.5	91.5	91.3	90.7	90.1
95.5	95.4	95.2	94.7	94.3	93.7	93.0	92.1	91.4	[illegible]
96.8	96.6	96.3	95.8	95.3	94.6	93.5	93.1	92.1	91.4
98.2	98.0	97.5	96.9	96.2	95.5	94.7	93.9	92.8	91.9
[illegible]	[illegible]	[illegible]	[illegible]	97.3	96.4	95.5	94.6	93.7	92.5
[illegible]	[illegible]	[illegible]	99.4	98.3	97.2	[illegible]	95.2	94.3	93.0
[illegible]	[illegible]	[illegible]	[illegible]	99.3	98.0	96.9	95.9	94.8	93.7
		[illegible]	[illegible]	[illegible]	99.7	97.4	96.3	95.2	94.1
		105.4	102.8	100.5	99.3	97.9	96.6	[illegible]	94.4
		106.1	103.4	101.3	99.6	98.2	96.9	95.7	94.6
		[illegible]	[illegible]	[illegible]	99.7	98.3	97.0	95.9	94.7
[illegible]	107.7	105.4	103.2	101.3	99.7	98.3	97.6	95.9	94.8
[illegible]	[illegible]	104.7	102.6	101.1	99.5	98.2	97.0	95.8	94.5
106.7	105.7	[illegible]	[illegible]	100.7	99.3	98.0	96.8	95.7	94.4
105.7	104.6	103.4	101.9	100.4	99.0	97.6	96.7	95.4	94.2
105.1	104.1	102.5	101.4	100.0	98.7	97.5	96.4	95.1	94.0
104.3	103.4	102.2	100.9	99.6	98.3	97.2	95.9	94.9	93.7
103.6	102.7	101.6	100.4	99.1	97.9	96.7	95.7	94.6	93.4
[illegible]	[illegible]	101.0	99.8	98.6	97.4	96.3	95.3	94.3	93.1
[illegible]	101.4	100.4	99.2	98.1	97.0	95.9	95.0	94.0	92.8
101.8	100.8	99.8	98.7	97.6	96.6	95.5	94.6	93.6	92.5
[illegible]	100.3	99.3	98.3	97.2	96.2	95.2	94.3	93.3	92.2
100.9	99.8	98.8	97.8	96.8	95.8	94.8	93.9	92.0	91.9
100.3	99.4	98.4	97.4	96.4	95.5	94.5	93.6	92.6	91.6
99.8	[illegible]	[illegible]	97.1	96.2	95.2	94.3	93.3	92.4	91.3
100.0	98.9	97.8	96.9	95.9	95.0	94.0	93.2	92.2	91.2
99.2	98.6	97.6	96.7	95.7	94.8	93.9	93.0	92.0	91.0
99.7	98.5	97.5	96.5	95.6	94.6	93.8	92.8	92.0	90.9
99.1	98.3	97.3	96.3	95.4	94.5	93.6	92.7	91.8	90.9
99.1	98.1	97.1	96.2	95.3	94.4	93.5	92.6	91.7	90.7
99.2	98.0	97.0	96.0	95.1	94.2	93.3	92.4	91.6	90.6
98.5	97.8	96.8	95.9	95.0	94.1	93.2	92.4	91.4	90.5
[illegible]	97.7	96.7	95.8	94.8	94.0	93.1	92.2	91.3	90.4

STAGE LENGTH (MI.)	25.	[illegible]	75.	[illegible]	150.	[illegible]	[illegible]	400.	[illegible]
CRUISE ALTITUDE (FT.)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	15000.	15000.
CRUISE SPEED (MPH)	256.	[illegible]	[illegible]	427.	427.	427.	427.	427.	427.
CRUISE L/D	12.26	[illegible]	[illegible]	9.37	[illegible]	9.91	9.91	9.91	9.91
CRUISE DISTANCE (MI.)	10.4	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	233.4	333.4	[illegible]
BLOCK TIME (MIN.)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	37.4	51.5	65.5	79.6
BLOCK FUEL (LB.)	[illegible]	[illegible]	[illegible]	713.	[illegible]	1332.	[illegible]	2540.	[illegible]
BLOCK SPEED (MPH)	[illegible]	[illegible]	[illegible]	252.	[illegible]	321.	350.	366.	377.

DIRECT OPERATING COST - [illegible] UTILIZATION [illegible] DEPRECIATION PERIOD(YR)=1[illegible] LABOR RATE($/HR)= 7.[illegible]
AIRFRAME COST ($/LB)= [illegible] ENGINE COST ($/HP)= [illegible] INSURANCE RATE=0.040 FUEL COST (CENTS/GAL)= 18.0
[illegible]=1.35+0.0255*SL $/SEAT-TRIP (SL= [illegible])
HOP LENGTHS [illegible]

STAGE LENGTH	[illegible]	[illegible]	75.	[illegible]	[illegible]	[illegible]	[illegible]	400.	500.	200.	300.	400.
ACFT CYCLES/STARTS	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	2/1	2/1	2/1
FLIGHT CREW	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.262	0.254	0.380	0.332	0.307
FUEL & OIL	[illegible]	[illegible]	0.211	[illegible]	[illegible]	[illegible]	[illegible]	0.177	0.174	0.198	0.190	0.185
HULL INSURANCE	[illegible]	[illegible]	0.229	[illegible]	[illegible]	[illegible]	[illegible]	0.148	0.144	0.206	0.131	0.159
TOTAL FLIGHT OPS	[illegible]	[illegible]	[illegible]	0.772	[illegible]	[illegible]	[illegible]	0.586	0.572	0.784	0.703	0.661
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.362	[illegible]	[illegible]	[illegible]	[illegible]	0.075	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.389	[illegible]	[illegible]
MATERIAL ENGINES	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
MAINT. BURDEN	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.228	[illegible]	0.404	[illegible]	0.287
TOTAL MAINTENANCE	[illegible]	[illegible]	[illegible]	[illegible]	0.765	[illegible]	[illegible]	[illegible]	0.470	0.512	0.732	[illegible]
DEPRECIATION	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.595	[illegible]	[illegible]
TOTAL DIRECT OPERATING COST												
$/[illegible] MILE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1.515	1.457	2.297	1.961	1.786
$/FLIGHT HOUR	[illegible]	[illegible]	[illegible]	611.5	[illegible]	577.8	[illegible]	555.1	[illegible]	[illegible]	585.0	[illegible]
$/SEAT MILE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.0303	0.0291	0.0459	0.0392	0.0357
$/SEAT-TRIP	[illegible]	[illegible]	4.	4.67	5.97	7.23	[illegible]	12.12	14.57	9.19	11.76	14.29

DEPARTURE

TIME HISTORY AT 500 FT SIDELINE
TIME= 1.5 4.5 7.5 10.5 13.5 16.5 19.5 22.5 25.5 28.5 31.5 34.5 37.5 40.5 43.5 46.5 49.5 52.5 55.5 58.5
61.5 64.5 67.5 70.5 73.5 76.5
FNL = 87.9 88.7 85.5 92.1 94.5 96.6 97.2 96.7 95.4 93.5 91.1 88.2 84.6 80.9 77.4 74.7 71.8 69.6 67.8 66.1
64.5 63.0 61.5 59.9 57.8 54.9

ARRIVAL

TIME HISTORY AT [illegible] FT SIDELINE
TIME= [illegible]
FNL = [illegible]

C-80-50 ARRIVAL

94.4	94.3	94.1	93.6	93.2	92.8	92.3	91.8	91.2	90.7
95.4	95.2	95.0	94.7	94.2	93.5	93.0	92.4	91.8	91.2
96.3	96.1	95.9	95.5	95.0	94.4	93.7	92.9	92.3	91.6
97.4	97.2	96.8	96.4	95.8	95.1	94.5	93.7	92.8	92.1
98.6	98.4	97.9	97.3	96.5	95.8	95.0	94.3	93.3	92.5
100.1	99.7	99.0	98.2	97.3	96.4	95.6	94.7	93.9	92.8
101.8	101.2	100.2	99.0	98.1	97.0	96.0	95.1	94.2	93.1
104.1	102.1	101.6	100.0	98.8	97.6	96.4	95.4	94.5	93.6
		102.9	100.8	99.3	97.9	96.8	95.7	94.8	93.9
		103.8	101.3	99.6	98.2	97.0	95.9	95.0	94.1
		104.1	101.5	99.8	98.3	97.1	96.1	95.1	94.2
		104.2	101.7	100.0	98.6	97.4	96.3	95.3	94.5
112.4	107.2	104.0	101.8	100.2	98.8	97.6	96.5	95.6	94.7
111.5	107.1	104.1	101.9	100.4	99.0	97.9	96.8	95.9	94.8
110.7	107.1	104.2	102.2	100.6	99.2	98.1	97.1	96.1	94.9
110.1	107.0	104.4	102.4	100.8	99.5	98.3	97.3	96.3	95.2
109.6	107.0	104.5	102.6	101.0	99.7	98.5	97.5	96.4	95.4
109.1	106.9	104.6	102.7	101.2	99.8	98.7	97.6	96.5	95.6
109.0	106.7	104.6	102.8	101.3	100.0	98.8	97.7	96.7	95.8
108.0	106.6	104.7	102.9	101.4	100.1	98.9	97.9	96.9	95.9
107.5	106.4	104.6	103.0	101.5	100.2	99.1	98.0	97.1	96.1
107.1	106.2	104.5	103.0	101.6	100.3	99.2	98.2	97.2	96.2
106.8	106.0	104.5	103.0	101.7	100.4	99.3	98.3	97.3	96.3
106.3	105.8	104.4	103.0	101.7	100.5	99.4	98.4	97.4	96.5
106.1	105.6	104.3	103.0	101.8	100.6	99.5	98.5	97.6	96.6
105.8	105.4	104.2	103.1	101.8	100.7	99.6	98.6	97.7	96.7
105.5	105.2	104.1	102.9	101.8	100.7	99.7	98.7	97.8	96.8
105.3	105.0	104.0	102.9	101.8	100.7	99.7	98.8	97.9	96.9
105.1	104.8	103.9	102.8	101.8	100.8	99.8	98.8	97.9	97.0
104.8	104.6	103.6	102.8	101.8	100.8	99.8	98.9	98.0	97.1
104.5	104.4	103.7	102.7	101.7	100.8	99.9	98.9	98.0	97.1
104.3	104.2	103.5	102.6	101.7	100.8	99.9	99.0	98.1	97.1
104.1	104.0	103.4	102.6	101.7	100.8	99.9	99.0	98.1	97.2
103.9	103.8	103.3	102.5	101.6	100.7	99.9	99.0	98.2	97.2

N-6C-5C

DEPARTURE PATH TO 10,000 FT MSL
MAX FUSE ANGLE=20. OBSTACLE CLEAR ANGLE=60. OBSTACLE HEIGHT=100. MAX ACCEL ROTATION RATE=20. ACCEL BUILDUP TIME= 5.

TIME SEC	DIST FT	ALT FT	VEL FPS	ACC G	GAM DEG	THRUST LB	LEGJ LB	LWCI LB	LWGI LB	LHCI LB	DFUST LB	ALF DEG	TFE DEG	AWD DEG	ALV DEG	LAMDA	MU	CT	POWER HP
OBSTACLE CLEARANCE																			
0.0	0.	0.	0.	0.0	60.0	44255.	0.	-56.	0.	1250.	0.	30.1	2.0	-57.1	30.5	0.0663	0.0	0.0088	5539.
8.6	11.	19.	5.	0.036	60.0	45673.	-2.	-515.	1.	604.	4.	29.7	24.6	-35.4	23.0	0.0715	0.0035	0.0091	5981.
10.5	18.	31.	10.	0.124	60.0	48381.	-7.	-640.	3.	629.	18.	27.5	24.6	-35.4	24.7	0.0761	0.0066	0.0097	6777.
11.5	27.	47.	15.	0.056	60.0	47255.	-15.	-645.	8.	576.	40.	28.2	24.6	-35.4	23.4	0.0789	0.0095	0.0094	6822.
13.9	44.	77.	20.	0.061	61.1	46004.	-27.	-650.	14.	547.	71.	29.0	24.6	-35.4	22.5	0.0811	0.0135	0.0092	6822.
14.6	58.	100.	21.	0.022	60.0	44594.	-43.	-649.	21.	518.	111.	30.0	24.6	-35.4	21.7	0.0836	0.0173	0.0089	6822.
ACCELERATION AND CONVERSION																			
18.8	116.	185.	29.	0.137	51.4	43860.	-59.	-855.	21.	215.	56.	33.6	24.6	-26.8	23.9	0.0856	0.0225	0.0092	6822.
21.3	171.	242.	35.	0.169	40.2	43546.	-138.	-1230.	21.	198.	66.	45.0	24.6	-15.6	30.0	0.0854	0.0348	0.0092	6822.
23.5	241.	293.	42.	0.129	32.5	44133.	-119.	-1545.	20.	150.	47.	51.8	24.6	-7.9	32.1	0.0849	0.0467	0.0092	6822.
25.6	320.	335.	49.	0.138	27.1	44285.	98.	-1739.	20.	132.	35.	56.7	24.6	-2.5	31.7	0.0846	0.0583	0.0092	6822.
27.4	411.	381.	57.	0.149	23.2	44365.	338.	-1562.	29.	126.	31.	59.9	24.6	1.4	30.1	0.0844	0.0699	0.0093	6822.
29.1	507.	420.	65.	0.166	21.2	44441.	756.	-2192.	44.	127.	35.	61.7	24.6	4.4	27.9	0.0841	0.0817	0.0093	6822.
30.7	611.	455.	73.	0.172	17.8	44402.	1235.	-2441.	68.	132.	48.	63.5	24.6	6.7	25.5	0.0841	0.0934	0.0093	6822.
32.3	727.	491.	82.	0.173	16.0	44256.	1736.	-2718.	95.	140.	69.	65.0	24.6	8.6	23.0	0.0841	0.1053	0.0092	6822.
33.8	857.	526.	90.	0.168	14.5	43573.	2350.	-2869.	139.	142.	97.	66.3	24.6	10.1	20.5	0.0846	0.1170	0.0092	6822.
35.4	999.	561.	98.	0.176	13.2	42556.	3049.	-1553.	187.	79.	133.	65.3	24.6	11.4	17.6	0.0873	0.1277	0.0089	6822.
36.5	1153.	596.	107.	0.174	12.1	40875.	3831.	-264.	243.	56.	178.	64.6	24.6	12.4	15.0	0.0917	0.1391	0.0085	6822.
38.5	1324.	631.	115.	0.167	11.2	38562.	4698.	1147.	307.	68.	231.	63.8	24.6	13.3	12.7	0.0949	0.1481	0.0081	6822.
40.2	1521.	669.	124.	0.153	10.5	37327.	5412.	2231.	351.	96.	270.	63.9	23.9	13.5	10.9	0.0989	0.1586	0.0078	6822.
42.0	1745.	709.	132.	0.147	9.8	35755.	6137.	3227.	394.	133.	308.	63.4	23.2	13.5	9.3	0.1030	0.1691	0.0075	6822.
43.9	2000.	751.	141.	0.137	9.2	34014.	6910.	4335.	435.	181.	349.	62.9	22.6	13.5	8.0	0.1090	0.1793	0.0071	6822.
45.9	2288.	797.	149.	0.130	8.7	32238.	7729.	5506.	487.	239.	392.	62.1	22.1	13.5	6.8	0.1139	0.1891	0.0067	6822.
48.0	2615.	845.	156.	0.119	8.2	30214.	8555.	6763.	533.	307.	439.	61.1	21.6	13.5	5.7	0.1210	0.1992	0.0063	6822.
50.4	2992.	896.	166.	0.110	7.8	28163.	9505.	8018.	592.	383.	488.	59.7	21.2	13.5	4.8	0.1295	0.2066	0.0059	6822.
52.9	3424.	955.	175.	0.104	7.4	25553.	10465.	9492.	648.	468.	535.	59.0	20.8	13.5	4.0	0.1410	0.2130	0.0054	6822.
55.9	3923.	1018.	183.	0.091	7.0	23744.	11476.	10972.	707.	561.	593.	55.7	20.5	13.5	3.3	0.1530	0.2192	0.0050	6822.
59.0	4522.	1091.	192.	0.076	6.7	21245.	12530.	12566.	768.	666.	650.	53.3	20.2	13.5	2.6	0.1738	0.2218	0.0044	6822.
62.6	5235.	1173.	201.	0.070	6.4	19507.	13631.	14203.	832.	774.	709.	49.3	19.9	13.5	2.0	0.1921	0.2196	0.0039	6822.
66.6	6064.	1262.	209.	0.066	6.2	16582.	14775.	15923.	899.	891.	771.	43.8	19.6	13.5	1.5	0.2158	0.2086	0.0035	6822.
70.7	6906.	1353.	218.	0.066	5.9	14407.	15974.	17722.	963.	1015.	836.	36.1	19.4	13.5	1.0	0.2545	0.1856	0.0030	6822.
74.6	7771.	1441.	226.	0.071	5.7	12565.	17216.	19596.	1031.	1145.	903.	25.5	19.1	13.5	0.6	0.2943	0.1416	0.0025	6822.
78.2	8611.	1520.	235.	0.076	5.5	11234.	18505.	21530.	1115.	1280.	973.	11.8	18.9	13.5	0.2	0.3317	0.0794	0.0024	6822.
79.3	8796.	1541.	237.	0.076	5.4	11097.	18798.	21961.	1132.	1310.	989.	8.5	19.9	13.5	0.2	0.3378	0.0520	0.0023	6822.
AIRPLANE MODE CLIMB TO 10,000 FT																			
93.7	12242.	1573.	237.	0.0	14.3	13515.													
238.3	47866.	10000.	269.	0.0	12.0	12233.													

THE NOISE ANNOYANCE IS 0.17655D+07 ONE POINT IN 1 OF THE GRID WAS USED

AT 500. FT. SIDELINE AND 0. FT. FORWARD, NOISE= 99.4 EPNDB
AT 1000. FT. SIDELINE AND 0. FT. FORWARD, NOISE= 92.6 EPNDB
AT 10000. FT. SIDELINE AND 0. FT. FORWARD, NOISE= 66.0 EPNDB
AT 20000. FT. SIDELINE AND 0. FT. FORWARD, NOISE= 0.0 EPNDB
AT 0. FT. SIDELINE AND-20000. FT. FORWARD, NOISE= 0.0 EPNDB
AT 0. FT. SIDELINE AND -5000. FT. FORWARD, NOISE= 71.6 EPNDB
AT 0. FT. SIDELINE AND 6000. FT. FORWARD, NOISE= 88.1 EPNDB
AT 0. FT. SIDELINE AND 30000. FT. FORWARD, NOISE= 0.0 EPNDB
AT 0. FT. SIDELINE AND 51000. FT. FORWARD, NOISE= 0.0 EPNDB
AT 0. FT. SIDELINE AND 2500. FT. FORWARD, NOISE= 93.2 EPNDB

M-EC-5C

ARRIVAL PATH FROM 10,000 FT MSL
TERMINAL AREA SPEED = 200. KIAS, FINAL APPROACH SPEED = 60. KIAS, FINAL APPROACH SLOPE = 8.0 DEG, ACCEL BUILDUP TIME = 5. SEC
MAX DOWNWARD FUSE ANGLE =10.0 DEG

TIME SEC	DIST FT	ALT FT	VEL FPS	ACC G	GAM DEG	THRUST LB	LWG LB	RWG LB	FNAC LB	FLG LB	CFUST LB	ALF DEG	THE DEG	AWJ DEG	ALV DEG	LAMBDA	MU	CT	POWER HP
AIRPLANE MODE DESCENT																			
0.0	0.	10000.	491.	0.0	-4.9	0.													
190.4	88397.	3175.	441.	0.0	-4.9	0.													
195.7	92510.	3000.	441.	0.0	0.0	0.													
AIRPLANE MODE DECELERATION																			
212.6	98957.	3000.	423.	-0.085	0.0	0.													
219.9	100686.	3000.	406.	-0.091	0.0	0.													
224.6	102560.	3000.	388.	-0.101	0.0	0.													
229.7	104512.	3000.	371.	-0.112	0.0	0.													
239.5	108438.	3000.	353.	0.0	0.0	4552.													
AIRPLANE MODE DESCENT																			
254.3	113795.	2627.	353.	0.0	-8.0	0.													
273.9	120414.	1785.	345.	0.0	-8.0	0.													
285.8	124512.	1500.	345.	0.0	0.0	0.													
DECELERATION AND CONVERSION																			
291.1	126315.	1500.	328.	-0.200	0.0	0.						4.2							
293.8	127171.	1500.	311.	-0.200	0.0	136.						0.0							
296.5	127980.	1500.	293.	-0.200	0.0	2635.	37903.	5217.	1781.	1597.	750.	36.4	1.9	1.9	0.1	0.3372	0.2499	0.0006	2551.
299.2	128742.	1500.	276.	-0.200	0.0	5608.	35056.	5458.	2827.	1769.	700.	53.6	1.9	1.9	0.3	0.2357	0.3173	0.0012	3394.
301.9	129459.	1500.	259.	-0.200	0.0	8515.	31554.	5550.	3183.	1555.	615.	66.1	1.9	1.9	0.7	0.1518	0.3292	0.0019	35[illegible].
304.5	130129.	1500.	242.	-0.200	0.0	12593.	27472.	5452.	3159.	1354.	536.	75.2	1.9	1.9	1.2	0.0914	0.3338	0.0027	3172.
307.2	130753.	1500.	224.	-0.200	0.0	16549.	23592.	5233.	2733.	1169.	462.	81.6	1.9	1.9	1.9	0.0519	0.3173	0.0035	2665.
309.9	131331.	1500.	207.	-0.200	0.0	20608.	19487.	495[illegible].	2418.	995.	394.	86.3	1.9	1.9	2.8	0.0277	0.2951	0.0043	2146.
312.6	131862.	1500.	190.	-0.200	0.0	24661.	15449.	4516.	2141.	836.	331.	89.3	1.9	1.9	4.0	0.0130	0.2711	0.0052	1695.
315.2	132346.	1500.	173.	-0.200	0.0	28579.	11585.	3940.	1656.	691.	273.	91.7	1.9	1.9	5.7	0.0049	0.2464	0.0060	1351.
317.9	132791.	1500.	155.	-0.197	0.0	32188.	8255.	3274.	1363.	54[illegible].	221.	93.5	1.9	1.9	7.9	0.0037	0.2219	0.0067	1271.
320.7	133197.	1500.	138.	-0.193	0.0	35552.	4784.	2487.	1074.	442.	175.	94.8	1.9	1.9	11.0	0.0041	0.1966	0.0074	1271.
323.5	133557.	1500.	121.	-0.156	0.0	37556.	2925.	1812.	913.	3[illegible].	134.	9[illegible].7	1.9	1.9	15.2	[illegible]	0.171[illegible]	0.00[illegible]	1271.
329.0	134171.	15[illegible].	1[illegible].	[illegible]	0.0	38234.	21[illegible].	1435.	[illegible]	[illegible]	58.	[illegible]	1.9	1.9	19.1	0.0360	0.1475	0.0080	3195.
HELICOPTER MODE FINAL APPROACH																			
333.5	134634.	1468.	104.	[illegible]	-8.0	37696.	2236.	1392.	605.	241.	94.	94.5	-5.4	2.6	21.2	0.0151	0.1474	0.0079	1874.
423.5	143767.	194.	101.	0.0	-8.0	27696.	2226.	1392.	605.	24[illegible].	94.	94.5	-5.4	2.6	20.2	0.0149	0.1442	0.0075	1896.
DECELERATION TO HOVER																			
430.5	144435.	9[illegible].	84.	-0.143	-8.0	39546.	1564.	988.	[illegible]	171.	60.	1[illegible].4	-5.4	2.6	32.0	0.0055	0.1172	0.0079	1328.
433.9	144669.	57.	68.	-0.200	-8.0	41062.	930.	715.	247.	111.	42.	107.9	-5.4	2.6	50.2	0.0147	0.0915	0.0082	1910.
436.5	144822.	36.	51.	-0.200	-8.0	41766.	351.	715.	132.	62.	24.	108.2	-5.4	2.6	69.7	0.0225	0.0688	0.0083	2385.
439.1	144932.	20.	34.	-0.200	-8.0	42423.	-54.	530.	59.	28.	10.	108.3	-5.4	2.6	85.9	0.0485	0.0458	0.0085	4190.
441.8	144998.	11.	17.	-0.200	-8.0	42796.	-219.	1034.	24.	7.	3.	108.5	-5.4	2.6	98.1	0.0594	0.0229	0.0085	4935.
447.0	145041.	5.	0.	[illegible]	-8.0	41124.	-371.	1[illegible]1.	9.	.	9.	97.9	-5.4	2.6	97.8	0.0640	0.0	0.0082	5071.
LAND																			
452.0	145041.	0.	0.	0.0	-90.0	41034.	34.	-1033.	[illegible]	[illegible]	0.	-180.0	2.9	92.9	180.0	0.0640	0.0	0.0082	5074.

THE NOISE ANNOYANCE IS 0.30759[illegible]+07 ONE POINT IN 1 OF THE GRID WAS USED

AT 500. FT. SIDELINE AND 0. FT. FORWARD, NOISE= 94.5 EPNDB
AT 1000. FT. SIDELINE AND 0. FT. FORWARD, NOISE= 97.8 EPNDB
AT 10000. FT. SIDELINE AND 0. FT. FORWARD, NOISE= 64.2 EPNDB
AT 20000. FT. SIDELINE AND 0. FT. FORWARD, NOISE= [illegible] EPNDB
AT 0. FT. SIDELINE AND-20000. FT. FORWARD, NOISE= 0.0 EPNDB
AT 0. FT. SIDELINE AND -5000. FT. FORWARD, NOISE= 76.7 EPNDB
AT 0. FT. SIDELINE AND 6000. FT. FORWARD, NOISE= 94.4 EPNDB
AT 0. FT. SIDELINE AND 30000. FT. FORWARD, NOISE= 67.0 EPNDB
AT 0. FT. SIDELINE AND 51000. FT. FORWARD, NOISE= [illegible] EPNDB
AT 0. FT. SIDELINE AND 2500. FT. FORWARD, NOISE= 95.4 EPNDB

M-80-50 DEPARTURE

[illegible]	82.6	81.9	82.3	81.9	81.4	[illegible]	[illegible]	[illegible]	[illegible]
83.0	82.9	82.7	82.4	82.1	92.4	81.8	81.1	80.4	79.8
84.3	84.2	83.8	83.4	82.9	92.5	82.3	81.9	81.2	80.4
85.6	85.5	85.2	84.6	[illegible]	83.3	[illegible]	82.4	82.0	81.1
87.9	87.2	86.7	86.0	85.1	84.3	83.3	82.6	82.8	81.6
89.5	89.1	88.4	87.4	86.4	85.3	84.2	83.2	82.5	82.4
91.5	91.1	89.9	89.3	87.7	86.4	85.1	83.9	82.9	83.0
95.1	93.9	92.3	90.4	88.9	87.4	85.9	84.6	83.4	82.0
		94.9	92.1	90.1	86.2	86.6	85.2	83.9	82.0
		96.5	93.4	91.0	89.0	87.2	85.6	84.2	83.1
		97.7	94.3	91.7	89.5	87.6	85.9	84.5	83.3
		97.7	94.5	92.0	89.7	87.8	86.1	84.6	83.3
102.2	100.1	97.2	94.2	91.9	89.7	87.8	86.1	84.6	93.3
100.2	[illegible]	96.4	93.8	91.7	89.6	87.8	86.1	84.7	84.0
[illegible]	97.6	[illegible]	[illegible]	91.2	89.3	[illegible]	85.9	84.4	84.1
97.7	[illegible]	[illegible]	[illegible]	90.6	88.8	87.1	85.6	84.5	84.1
96.4	95.3	93.7	91.6	[illegible]	88.2	86.6	85.1	84.5	83.9
95.2	94.2	92.6	[illegible]	89.2	87.6	86.0	85.2	84.1	83.5
94.3	[illegible]	91.7	[illegible]	88.4	87.0	85.0	[illegible]	83.9	83.3
[illegible]	[illegible]	90.7	89.2	87.9	86.5	85.4	84.3	83.4	83.0
92.4	91.2	89.9	[illegible]	87.2	86.0	84.9	83.9	83.0	82.7
91.2	90.3	[illegible]	87.9	86.6	85.4	84.3	83.4	82.6	82.0
90.3	[illegible]	[illegible]	87.2	86.1	84.9	83.9	83.1	82.1	81.0
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	84.4	[illegible]	[illegible]	81.4	81.2
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	87.1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	87.7	86.6	[illegible]	[illegible]	83.6	[illegible]	[illegible]	81.0	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	83.2	[illegible]	81.3	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	83.5	82.8	[illegible]	[illegible]	[illegible]	79.9
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	80.4	79.9
[illegible]	[illegible]	[illegible]	[illegible]	83.5	82.5	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

ORIGINAL PAGE IS
OF POOR QUALITY

M-80-50 ARRIVAL

83.7	83.3	83.6	83.7	82.3	92.7	82.2	81.5	8[illegible].7	[illegible]
84.7	84.6	84.3	84.2	83.7	83.6	82.5	82.1	81.3	80.5
85.8	85.6	85.4	84.9	84.5	84.0	83.5	82.8	81.8	80.9
87.0	86.9	86.5	86.0	85.4	84.8	82.8	83.3	82.5	81.3
88.9	88.3	87.9	87.1	86.2	85.3	84.4	83.4	83.0	81.9
90.4	90.1	89.4	88.4	87.2	85.9	84.0	83.7	82.9	82.3
92.5	91.9	90.8	89.0	88.0	86.5	85.1	83.8	82.7	82.5
95.6	94.6	92.6	90.2	88.6	86.7	85.0	83.6	82.3	81.6
		93.9	92.6	88.4	86.3	84.5	83.0	81.9	81.[illegible]
		93.2	89.1	87.2	85.2	83.7	82.3	81.5	80.5
		93.3	89.5	87.7	85.8	84.3	83.2	82.1	81.3
		94.4	9[illegible]	88.8	86.8	85.3	84.[illegible]	82.9	82.[illegible]
109.0	98.5	94.3	91.2	89.4	87.5	85.9	84.6	83.5	82.6
124.0	98.3	94.1	91.2	89.6	87.9	86.4	85.1	84.0	83.4
103.1	98.3	94.3	91.7	89.7	88.1	86.7	85.4	84.3	83.7
102.3	98.3	94.5	91.3	89.8	88.2	86.7	85.7	84.8	83.5
101.5	98.2	94.7	92.1	90.0	88.4	87.0	85.9	85.0	84.2
100.7	98.1	94.9	92.3	90.2	88.0	87.2	86.2	85.2	84.4
100.0	98.0	95.1	92.5	90.9	88.8	87.5	86.4	85.3	84.5
99.[illegible]	97.8	95.[illegible]	92.[illegible]	91.8	89.1	87.7	86.4	85.5	84.6
99.0	97.5	95.2	92.9	91.0	89.3	87.8	86.7	85.7	84.9
98.6	97.3	95.1	93.1	91.1	89.4	88.0	86.8	85.8	85.0
98.1	97.2	95.1	93.1	91.2	89.7	88.2	87.[illegible]	85.9	85.1
97.6	96.8	95.0	93.2	91.4	89.8	88.5	87.1	86.1	85.2
97.1	96.5	94.9	93.2	91.5	90.0	88.8	87.4	86.3	85.4
96.7	96.2	94.8	93.2	91.6	90.1	88.7	87.5	86.4	85.5
96.4	96.0	94.6	93.2	91.7	90.[illegible]	88.[illegible]	87.[illegible]	86.5	85.6
96.1	95.7	94.5	93.1	91.7	90.3	[illegible]	[illegible]	86.7	85.8
95.3	95.5	94.4	93.[illegible]	91.7	[illegible]	[illegible]	87.[illegible]	[illegible]	[illegible]
95.4	95.2	94.2	93.0	91.7	90.4	[illegible]	[illegible]	[illegible]	86.1
95.1	94.9	94.1	92.9	91.7	90.[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
94.9	94.7	94.0	92.3	91.6	90.[illegible]	[illegible]	[illegible]	87.3	[illegible]
94.6	94.5	93.8	92.7	91.6	90.9	[illegible]	[illegible]	[illegible]	[illegible]
94.4	94.2	93.6	92.6	91.6	90.5	[illegible]	[illegible]	[illegible]	[illegible]

Q-SC-50

STAGE LENGTH (MI.)	25.	50.	75.	100.	150.	200.	300.	400.	500.
CRUISE ALTITUDE (FT.)	2000.	4000.	10001.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
CRUISE SPEED (MPH)	296.	[illegible]	[illegible]	411.	411.	411.	411.	411.	411.
CRUISE L/D	11.54	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	9.53	[illegible]
CRUISE DISTANCE (MI.)	[illegible]	[illegible]	[illegible]	42.2	[illegible]	136.3	[illegible]	336.3	[illegible]
BLOCK TIME (MIN.)	[illegible]	15.1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	67.5	[illegible]
BLOCK FUEL (LBS)	249.	[illegible]	[illegible]	[illegible]	[illegible]	1273.	[illegible]	2433.	[illegible]
BLOCK SPEED (MPH)	153.	194.	[illegible]	255.	291.	314.	341.	356.	366.

DIRECT OPERATING COST - ANN UTILIZATION(HR)=2000. DEPRECIATION PERIOD(YR)=10. LABOR RATE($/HR)= 7.00
AIRFRAME COST ($/LB)= [illegible] ENGINE COST ($/HP)= [illegible] INSURANCE RATE=[illegible] FUEL COST (CENTS/GAL)= 19.0
DOC=1.61+0.0265*SL $/SEAT-TRIP (SL= 25.,500.)
FLF LENGTHS 50+150+ 0+ 0+ 0=200 100+200+ 0+ 0+ 0=300 200+200+ 0+ 0+ 0=400

STAGE LENGTH	25.	50.	75.	100.	150.	200.	300.	400.	500.	200.	300.	400.
NO. CYCLES/STARTS	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	2/1	2/1	2/1
FLIGHT CREW	0.635	[illegible]	0.465	[illegible]	0.328	[illegible]	[illegible]	0.268	0.261	[illegible]	0.336	0.312
FUEL & OIL	0.277	0.212	0.201	[illegible]	0.181	0.177	[illegible]	0.155	0.167	0.129	0.101	0.177
HULL INSURANCE	0.371	0.281	0.237	0.215	0.192	0.173	[illegible]	0.157	0.153	0.214	0.193	0.176
TOTAL FLIGHT OPS	[illegible]	[illegible]	0.943	0.773	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.765	0.737	[illegible]
LABOR AIRFRAME	[illegible]	[illegible]	0.266	0.229	0.192	0.171	[illegible]	[illegible]	[illegible]	0.226	0.189	0.170
MATERIAL AIRFRAME	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
LABOR ENGINES	[illegible]	[illegible]	0.122	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.389	[illegible]	[illegible]
MATERIAL ENGINES	[illegible]	[illegible]	0.173	0.137	[illegible]	[illegible]	[illegible]	[illegible]	0.047	0.121	[illegible]	[illegible]
MAT. BURDEN	[illegible]	[illegible]	[illegible]	[illegible]	0.344	[illegible]	[illegible]	0.236	0.223	[illegible]	0.333	[illegible]
TOTAL MAINTENANCE	2.562	[illegible]	1.163	0.965	0.773	0.670	[illegible]	0.514	[illegible]	0.923	0.741	0.646
DEPRECIATION	1.169	0.813	0.682	0.623	0.552	0.512	0.472	0.452	[illegible]	0.617	0.549	0.512
TOTAL DIRECT OPERATING COST												
$/AIRCRAFT MILE	4.523	[illegible]	2.635	[illegible]	2.027	[illegible]	[illegible]	1.560	1.503	2.325	[illegible]	[illegible]
$/FLIGHT HOUR	741.5	[illegible]	632.4	612.2	585.8	577.7	563.3	555.	549.5	615.9	595.4	573.4
$/SEAT MILE	0.0567	[illegible]	0.0537	0.0472	0.0435	[illegible]	[illegible]	0.0312	0.0301	0.0465	0.0399	0.0365
$/SEAT-TRIP	2.47	3.33	4.03	4.72	[illegible]	7.35	[illegible]	12.48	15.03	9.30	11.98	14.62

DEPARTURE

TIME HISTORY AT 500 FT SIDELINE

TIME =	1.5	4.5	7.5	10.5	13.5	16.5	19.5	22.5	25.5	28.5	31.5	34.5	37.5	40.5	43.5	46.5	49.5
PNL =	66.6	66.6	87.1	89.1	91.3	92.1	91.3	89.1	86.0	82.2	77.9	73.5	69.3	66.9	64.4	62.2	60.2

ARRIVAL

TIME HISTORY AT 500 FT SIDELINE

TIME =	388.5	391.5	394.5	397.5	400.5	403.5	406.5	409.5	412.5	415.5	418.5	421.5	424.5	[illegible]	[illegible]	[illegible]	[illegible]
PNL =	63.5	[illegible]	[illegible]	66.6	67.9	[illegible]	71.3	72.7	74.4	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

9-80-50

DEPARTURE PATH TO 10,000 FT MSL

MAX FUSE ANGLE=20. OBSTACLE CLEAR ANGLE=60. OBSTACLE HEIGHT=100. MAX ACCEL ROTATION RATE=20. ACCEL BUILDUP TIME= 5.

TIME SEC	DIST FT	ALT FT	VEL FPS	ACC G	GAM DEG	THRUST LB	LWGO LB	LWGI LB	DWGO LB	DWGI LB	DFUST LB	ALP DEG	THE DEG	AWD DEG	ALV DEG	LAMDA	MU	CT	POWER HP
OBSTACLE CLEARANCE																			
0.0	0.	0.	0.	0.0	60.0	45420.	0.	-59.	0.	1297.	0.	30.1	2.9	-57.1	30.5	0.0679	0.0	0.0092	5219.
8.6	11.	19.	5.	0.036	60.0	46246.	-2.	-531.	1.	712.	4.	29.7	24.6	-35.4	27.9	0.0721	0.1335	0.0095	5630.
10.5	18.	31.	10.	0.124	60.0	49631.	-6.	-674.	4.	646.	18.	27.5	24.6	-35.4	24.5	0.0786	0.1373	0.0102	6438.
11.5	24.	41.	15.	0.204	60.0	52843.	-18.	-757.	9.	611.	40.	25.8	24.6	-35.4	21.9	0.0844	0.0104	0.0108	7203.
12.3	31.	54.	20.	0.158	60.0	51012.	-32.	-756.	16.	554.	71.	26.8	24.6	-35.4	20.4	0.0875	0.0138	0.0104	7203.
13.5	44.	77.	25.	0.114	60.0	49316.	-59.	-751.	25.	523.	111.	27.7	24.6	-35.4	19.7	0.0905	0.0179	0.0101	7203.
14.3	56.	100.	27.	0.072	60.0	47755.	-72.	-755.	36.	508.	160.	28.7	24.6	-35.4	19.0	0.0934	0.0222	0.0098	7203.
ACCELERATION AND CONVERSION																			
16.0	88.	146.	34.	0.207	53.4	45757.	-110.	-956.	37.	320.	151.	26.0	24.6	-28.8	16.6	0.0981	0.0239	0.0098	7203.
17.3	118.	180.	40.	0.188	44.2	45713.	-189.	-1253.	36.	241.	117.	36.6	24.6	-19.6	21.3	0.0981	0.0366	0.0098	7203.
18.6	160.	217.	46.	0.188	37.2	45535.	-210.	-1534.	35.	198.	90.	43.8	24.6	-12.7	24.3	0.0976	0.0497	0.0098	7203.
19.9	214.	254.	52.	0.183	32.0	46032.	-181.	-1792.	35.	174.	70.	49.4	24.6	-7.4	24.7	0.0973	0.0623	0.0098	7203.
21.3	279.	291.	59.	0.183	27.9	46066.	102.	-2045.	34.	163.	57.	53.4	24.6	-3.3	24.1	0.0971	0.0747	0.0098	7203.
22.6	353.	328.	66.	0.191	24.7	46115.	455.	-2311.	42.	160.	50.	56.1	24.6	-0.1	22.9	0.0969	0.0870	0.0098	7203.
23.9	436.	364.	74.	0.190	22.1	46076.	884.	-2595.	58.	162.	50.	58.5	24.6	2.5	21.4	0.0968	0.0993	0.0098	7203.
25.2	531.	400.	81.	0.187	20.0	45982.	1390.	-2907.	81.	169.	58.	60.5	24.6	4.6	19.7	0.0969	0.1116	0.0098	7203.
26.5	637.	437.	88.	0.182	18.2	45838.	1976.	-3254.	112.	180.	72.	62.2	24.6	6.3	17.9	0.0970	0.1239	0.0098	7203.
27.9	760.	476.	96.	0.171	16.8	44550.	2642.	-2272.	152.	123.	92.	62.8	24.6	7.8	15.7	0.0997	0.1348	0.0095	7203.
29.3	891.	514.	104.	0.190	15.5	43183.	3385.	-992.	199.	87.	120.	61.2	24.6	9.1	13.6	0.1026	0.1456	0.0092	7203.
30.7	1036.	552.	111.	0.163	14.4	41075.	4219.	488.	254.	82.	155.	61.8	24.6	10.2	11.6	0.1077	0.1551	0.0088	7203.
32.1	1199.	593.	119.	0.174	13.5	39296.	5131.	1931.	318.	107.	196.	60.9	24.6	11.1	11.0	0.1124	0.1654	0.0084	7203.
33.6	1377.	634.	127.	0.158	12.6	36948.	6125.	3560.	399.	162.	244.	59.4	24.6	12.0	8.4	0.1193	0.1742	0.0079	7203.
35.2	1582.	679.	134.	0.149	11.9	34546.	7203.	5268.	469.	243.	300.	58.0	24.6	12.7	7.0	0.1274	0.1925	0.0074	7203.
36.9	1813.	726.	142.	0.139	11.2	31955.	8363.	7095.	556.	345.	362.	56.1	24.6	13.4	5.8	0.1375	0.1895	0.1068	7203.
38.8	2080.	777.	150.	0.125	10.6	29652.	9554.	8613.	622.	444.	411.	54.9	24.2	13.5	4.8	0.1479	0.1962	0.0063	7203.
40.8	2389.	834.	159.	0.116	10.1	27567.	10294.	10010.	679.	533.	454.	53.2	23.6	13.5	4.0	0.1589	0.2026	0.0059	7203.
43.0	2739.	895.	166.	0.108	9.6	25411.	11281.	11488.	738.	629.	501.	51.0	23.2	13.5	3.3	0.1722	0.2071	0.0054	7203.
45.4	3135.	960.	173.	0.100	9.2	23189.	12314.	13049.	800.	735	549.	48.1	22.7	13.5	2.7	0.1896	0.2086	0.0050	7203.
48.0	3595.	1033.	181.	0.098	8.8	20757.	13393.	14736.	865.	852.	603.	44.8	22.3	13.5	2.1	0.2119	0.2037	0.0044	7203.
50.9	4121.	1113.	189.	0.084	8.4	19555.	14519.	16465.	933.	974.	653.	39.6	22.0	13.5	1.5	0.2366	0.1930	0.0040	7203.
53.9	4688.	1195.	197.	0.082	8.1	16489.	15691.	19277.	1003.	1103.	738.	32.7	21.6	13.5	1.1	0.2675	0.1707	0.0035	7203.
56.8	5281.	1277.	205.	0.083	7.8	14719.	15910.	21167.	1076.	1239.	765.	23.6	21.3	13.5	0.7	0.3020	0.1319	0.0031	7203.
59.8	5891.	1359.	213.	0.084	7.5	13394.	18174.	22122.	1152.	1380.	825.	12.1	21.0	13.5	0.3	0.3341	0.0721	0.0029	7203.
62.8	6543.	1443.	221.	0.078	7.2	12682.	15466.	24036.	1230.	1515.	888.	-0.8	20.7	13.5	0.0	0.3539	-0.0074	0.0027	7203.
64.5	7000.	1500.	226.	0.076	7.0	12421.	19756.	24353.	1216.	1495.	884.	-3.2	20.1	13.1	0.0	0.3612	-0.0212	0.0027	7203.
AIRPLANE MODE CLIMB TO 10,000 FT																			
79.1	10170.	1904.	226.	0.0	14.5	14324.													
225.5	45465.	10000.	257.	0.0	12.2	12585.													

THE NOISE ANNOYANCE IS 0.47246D+06 ONE POINT IN 1 OF THE GRID WAS USED

AT 500. FT. SIDELINE AND 0. FT. FORWARD, NOISE= 93.9 EPNDB
AT 1000. FT. SIDELINE AND 0. FT. FORWARD, NOISE= 86.1 EPNDB
AT 10000. FT. SIDELINE AND 0. FT. FORWARD, NOISE= 0.0 EPNDB
AT 20000. FT. SIDELINE AND 0. FT. FORWARD, NOISE= 0.0 EPNDB
AT 0. FT. SIDELINE AND-2100. FT. FORWARD, NOISE= 0.0 EPNDB
AT 0. FT. SIDELINE AND -5000. FT. FORWARD, NOISE= 0.0 EPNDB
AT 0. FT. SIDELINE AND 6000. FT. FORWARD, NOISE= 90.4 EPNDB
AT 0. FT. SIDELINE AND 30000. FT. FORWARD, NOISE= 0.0 EPNDB
AT 0. FT. SIDELINE AND 51000. FT. FORWARD, NOISE= 0.0 EPNDB
AT 0. FT. SIDELINE AND 2500. FT. FORWARD, NOISE= 87.2 EPNDB

G-EC-SC

ARRIVAL PATH FROM 10,000 FT MSL
TERMINAL AREA SPEED = 2[illegible]. KIAS, FINAL APPROACH SPEED = [illegible]. KIAS, FINAL APPROACH SLOPE = 8.0 DEG, ACCEL BUILDUP TIME = 5. SEC
MAX DOWNWARD FUSE ANGLE =10.0 DEG

TIME SEC	DIST FT	ALT FT	VEL FPS	ACC G	GAM DEG	THRUST LB	LWG LB	EWG LB	DNAC LB	DLG LB	DFUST LB	ALP DEG	THE DEG	AWD DEG	ALV DEG	LAMBDA	MU	CT	POWER HP
AIRPLANE MODE DESCENT																			
0.0	0.	10000.	491.	0.0	-5.0	0.													
184.5	85826.	3185.	441.	0.0	-5.0	0.													
194.5	90055.	3000.	441.	0.0	0.0	0.													
AIRPLANE MODE DECELERATION																			
207.0	95481.	3000.	423.	-0.087	0.0	0.													
213.0	97983.	3000.	406.	-0.094	0.0	0.													
218.5	100158.	3000.	388.	-0.106	0.0	0.													
223.4	102005.	3000.	371.	-0.115	0.0	0.													
232.6	105326.	3000.	353.	0.0	0.0	5506.													
AIRPLANE MODE DESCENT																			
247.7	110642.	2633.	353.	0.0	-7.9	0.													
267.2	117386.	1781.	345.	0.0	-7.9	0.													
275.0	121454.	1500.	345.	0.0	0.0	[illegible]													
DECELERATION AND CONVERSION																			
284.4	123257.	1500.	328.	-0.200	0.0	359.						0.0							
287.1	124112.	1500.	311.	-0.200	0.0	586.						0.0							
289.7	124921.	1500.	293.	-0.200	0.0	738.						0.0							
292.4	125663.	1500.	276.	-0.200	0.0	3591.	38468.	6244.	1818.	1801.	782.	38.8	1.0	1.0	0.2	0.3425	0.2745	0.0008	2840.
295.1	126400.	1500.	259.	-0.200	0.0	7012.	34931.	6364.	2793.	1583.	687.	56.7	1.0	1.0	0.4	0.2267	0.3438	0.0015	3543.
297.8	127073.	1500.	242.	-0.200	0.0	10831.	30932.	6315.	3022.	1379.	599.	69.2	1.0	1.0	0.8	0.1388	0.3586	0.0023	3453.
300.5	127694.	1500.	224.	-0.200	0.0	14990.	26458.	6101.	2840.	1189.	516.	77.7	1.0	1.0	1.4	0.0798	0.3480	0.0032	2986.
303.1	128272.	1500.	207.	-0.200	0.0	19349.	21991.	5735.	25[illegible].	1013.	443.	83.5	1.0	1.0	2.2	0.0433	0.3266	0.0042	2417.
305.8	128804.	1500.	190.	-0.200	0.0	23735.	17581.	5234.	2123.	851.	370.	87.5	1.0	1.0	3.2	0.0213	0.3010	0.0051	1883.
308.5	129289.	1500.	173.	-0.200	0.0	27988.	13364.	4612.	1757.	733.	305.	90.5	1.0	1.0	4.6	0.0086	0.2739	0.0060	1443.
311.2	129726.	1500.	155.	-0.202	0.0	31992.	9438.	3883.	1421.	570.	247.	93.0	1.0	1.0	6.4	0.0035	0.2463	0.0068	1203.
313.9	130127.	1500.	138.	-0.190	0.0	35665.	5837.	3049.	1121.	450.	196.	94.1	1.0	1.0	9.1	0.0041	0.2187	0.0076	1203.
316.7	130494.	1500.	121.	-0.188	0.0	38537.	3584.	2175.	855.	345.	150.	95.6	1.0	1.0	12.9	0.0345	0.1910	0.0082	1203.
322.4	131135.	1500.	104.	0.0	0.0	39346.	2128.	1715.	631.	253.	110.	85.5	1.0	1.0	16.5	0.0377	0.1638	0.0084	3027.
HELICOPTER MODE FINAL APPROACH																			
325.9	131558.	1468.	104.	0.0	-8.0	39476.	2637.	1679.	633.	253.	59.	94.1	-5.4	2.6	17.2	0.0135	0.1639	0.0082	1655.
414.1	140435.	226.	101.	0.0	-8.0	39476.	2637.	1579.	630.	253.	59.	94.1	-5.4	2.6	17.2	0.0132	0.1603	0.0079	1677.
DECELERATION TO HOVER																			
424.3	141372.	94.	84.	-0.103	-8.0	40587.	1839.	1235.	424.	176.	65.	101.4	-5.4	2.6	26.6	0.0359	0.1316	0.0082	1257.
427.7	141633.	57.	66.	-0.200	-8.0	42045.	1141.	329.	257.	113.	44.	107.7	-5.4	2.6	44.3	0.0095	0.1022	0.0086	1462.
430.4	141786.	36.	51.	-0.200	-8.0	42880.	45.	152.	146.	63.	25.	108.1	-5.4	2.6	65.1	0.0288	0.0764	0.0088	2631.
433.0	141856.	20.	34.	-0.200	-8.0	43650.	23.	961.	69.	29.	11.	108.3	-5.4	2.6	83.6	0.0474	0.0509	0.0089	3807.
435.6	141961.	11.	17.	-0.200	-8.0	44107.	-171.	1080.	24.	7.	3.	133.5	-5.4	2.6	97.2	0.0603	0.0254	0.0090	4636.
440.8	142005.	5.	0.	0.0	-8.0	42300.	-255.	1058.	8.	[illegible]	0.	97.9	-5.4	2.6	97.8	0.0657	0.0	0.0086	4805.
LAND																			
445.8	142005.	0.	0.	0.0	-90.0	42310.	36.	-1097.	8.	0.	0.	-180.0	2.9	92.9	179.9	0.0657	0.0	0.0086	4808.

THE NOISE ANNOYANCE IS 0.11617D+07 ONE POINT IN 1 OF THE GRID WAS USED

AT 500. FT. SIDELINE AND 0. FT. FORWARD, NOISE= 91.0 EPNDB
AT 1000. FT. SIDELINE AND 0. FT. FORWARD, NOISE= 93.7 EPNDB
AT 10000. FT. SIDELINE AND 0. FT. FORWARD, NOISE= 0.0 EPNDB
AT 20000. FT. SIDELINE AND 0. FT. FORWARD, NOISE= 0.0 EPNDB
AT 0. FT. SIDELINE AND-20000. FT. FORWARD, NOISE= 0.0 EPNDB
AT 0. FT. SIDELINE AND -5000. FT. FORWARD, NOISE= 0.0 EPNDB
AT 0. FT. SIDELINE AND 6000. FT. FORWARD, NOISE= 88.1 EPNDB
AT 0. FT. SIDELINE AND 30000. FT. FORWARD, NOISE= 0.0 EPNDB
AT 0. FT. SIDELINE AND 51000. FT. FORWARD, NOISE= 0.0 EPNDB
AT 0. FT. SIDELINE AND 2500. FT. FORWARD, NOISE= 94.9 EPNDB

9-80-50 DEPARTURE

72.2	71.3	71.0	70.6	68.6	65.2	0.0	0.0	0.0	0.0
74.9	74.7	74.4	74.0	72.1	70.6	68.2	0.0	0.0	0.0
77.5	77.2	76.1	75.6	74.6	73.8	71.8	69.9	0.0	0.0
79.1	78.9	78.4	77.7	76.2	75.3	74.0	71.8	69.7	0.0
81.0	80.7	80.1	79.2	78.2	76.7	75.4	73.3	71.5	0.0
83.2	82.7	81.9	80.9	79.7	78.5	76.3	75.1	72.9	71.0
84.3	83.6	79.2	74.9	81.0	79.6	78.2	75.9	74.1	71.5
89.2	87.8	84.0	80.8	82.3	80.6	79.0	76.8	75.1	72.8
		88.3	84.6	83.5	81.4	79.6	77.8	75.9	73.1
		90.4	85.9	84.4	82.2	80.3	78.4	76.2	73.9
		91.3	86.9	84.5	82.6	80.5	78.8	76.3	73.6
		91.2	86.8	85.1	82.7	80.6	78.7	76.4	73.7
96.8	93.9	90.1	86.5	84.9	82.6	80.5	78.2	76.0	73.6
94.6	92.3	89.2	85.9	84.7	82.5	80.6	78.2	76.1	74.2
93.0	91.3	88.9	86.5	84.3	82.3	80.0	78.3	75.9	74.5
91.7	90.0	87.9	85.7	83.7	81.6	79.7	77.7	75.9	73.0
90.4	88.8	86.9	84.9	82.8	80.9	78.9	77.3	75.1	71.7
88.9	87.0	85.8	84.0	82.1	80.3	78.7	76.8	74.9	70.0
87.9	86.4	84.9	83.2	81.4	79.8	78.2	76.8	72.8	0.0
86.6	85.4	84.0	82.4	80.8	79.3	77.3	74.8	70.2	0.0
85.9	84.5	83.1	81.5	80.0	78.1	76.1	73.0	68.3	0.0
85.0	83.7	82.2	80.6	79.1	77.0	74.4	72.0	68.2	0.0
84.6	83.2	81.6	79.9	78.1	76.3	74.1	71.2	68.2	0.0
84.0	82.7	81.1	79.5	77.9	75.9	73.4	71.0	66.1	0.0
84.[illegible]	82.4	80.8	79.2	77.7	76.0	72.5	71.0	68.1	0.0
83.1	82.0	80.5	78.9	77.2	74.6	73.1	70.0	65.2	0.0
82.4	81.7	80.3	78.6	76.9	74.8	72.2	70.7	65.1	0.0
82.3	81.2	79.6	77.9	76.1	74.1	72.6	69.1	64.8	0.0
82.0	80.8	79.1	77.6	76.1	73.9	71.0	70.2	0.0	0.
81.8	80.6	79.1	77.7	76.0	74.6	70.0	68.6	0.0	0.0
81.6	79.8	78.3	76.9	75.5	73.2	70.9	65.5	0.0	0.0
81.1	79.6	78.1	76.7	75.3	73.5	70.6	0.0	0.0	0.0
80.0	79.1	78.0	76.8	75.2	73.4	70.1	0.0	0.0	0.0
80.2	78.5	77.1	75.9	74.2	72.3	68.4	0.0	0.0	0.0

9-80-50 ARRIVAL

75.9	75.8	75.5	75.0	74.5	72.7	70.1	69.4	68.7	65.5
77.5	77.1	76.7	76.3	75.6	74.9	73.5	70.2	69.3	66.2
79.1	78.9	78.5	77.9	76.7	75.9	74.9	72.8	70.0	69.0
80.8	80.6	79.9	79.2	78.3	76.8	75.7	74.6	70.8	65.5
82.6	82.3	81.8	80.7	79.6	78.2	76.5	75.2	72.8	69.8
84.8	84.3	83.4	82.1	80.6	79.2	77.4	75.6	73.8	70.0
86.8	86.0	84.6	79.8	81.7	79.9	78.2	76.2	73.8	69.9
90.7	89.1	86.5	82.9	82.6	80.4	78.4	76.0	73.5	67.3
95.9	92.6	86.6	84.0	82.8	80.4	78.2	75.9	71.9	65.7
102.4	94.8	88.8	83.6	82.3	79.9	77.7	75.4	65.1	0.0
104.1	95.3	89.4	84.6	83.0	80.7	78.6	75.7	71.1	69.7
102.1	95.1	89.8	85.9	83.0	81.5	79.4	77.3	73.5	71.4
100.3	94.1	89.4	85.3	84.1	81.9	79.9	77.9	74.3	71.6
99.3	93.9	89.6	84.2	84.2	82.1	80.2	78.2	75.2	[illegible]
98.5	93.7	89.3	86.4	84.1	82.1	80.4	78.4	75.5	69.5
97.7	93.6	89.3	86.3	84.1	82.1	80.3	78.5	75.4	69.3
96.9	93.4	89.4	86.4	84.1	82.1	80.4	78.4	74.6	69.0
96.1	93.1	89.4	86.5	84.2	82.2	80.3	78.1	75.1	66.4
95.3	92.7	89.4	86.7	84.4	82.2	80.2	78.0	76.0	70.1
94.6	92.4	89.3	86.7	84.4	82.1	80.2	79.2	75.8	72.2
94.0	92.0	89.2	86.7	84.4	82.3	80.5	78.4	76.3	73.0
93.5	91.8	89.1	86.7	84.6	82.5	80.5	78.5	76.5	73.2
93.1	91.3	89.0	86.3	84.6	82.8	80.7	78.7	76.7	73.5
92.4	91.0	88.8	86.7	84.7	82.7	80.9	78.9	76.9	74.2
91.7	90.6	88.7	86.7	84.7	82.8	81.0	79.1	77.1	74.9
91.2	[illegible]	88.5	86.7	[illegible]	82.9	81.1	79.4	77.5	75.4
90.8	90.0	88.4	86.0	84.8	83.0	81.4	79.9	77.7	75.6
90.4	89.7	88.2	86.5	84.8	83.1	81.4	79.7	77.8	75.7
[illegible]	[illegible]	[illegible]	86.4	84.7	[illegible]	81.4	79.9	78.1	76.2
89.6	89.1	87.8	86.3	84.7	83.1	81.5	80.0	78.2	76.3
89.3	88.8	87.8	86.2	84.7	83.1	81.6	80.0	78.5	76.4
[illegible]	[illegible]	[illegible]	[illegible]	84.6	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
88.5	88.2	87.2	85.9	84.5	83.1	81.6	80.1	78.8	76.6
88.3	87.9	87.0	85.8	84.5	83.0	81.7	80.1	78.4	76.6

C-[illegible]-5[illegible]

STAGE LENGTH (MI.)	25.	50.	75.	100.	150.	200.	300.	400.	500.
CRUISE ALTITUDE (FT.)	[illegible]	[illegible]	1[illegible]	12[illegible]	15[illegible]	15[illegible]	15[illegible]	15[illegible]	15[illegible]
CRUISE SPEED (MPH)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	401.	401.	401.
CRUISE L/C	11.54	11.[illegible]3	[illegible]	[illegible]	[illegible]	[illegible]	[illegible].94	[illegible].94	[illegible]
CRUISE DISTANCE (MI.)	1[illegible].3	31.[illegible]	24.3	43.1	[illegible]	136.6	236.6	336.6	4[illegible].6
BLOCK TIME (MIN.)	1[illegible].1	1[illegible]	19.[illegible]	23.6	[illegible]	[illegible]	54.0	69.0	[illegible]
BLOCK FUEL (LBS)	247.	[illegible]	[illegible]	672.	[illegible]	1245.	1817.	2276.	2[illegible]31.
BLOCK SPEED (MPH)	1[illegible]	1[illegible]7.	[illegible]	254.	[illegible]	[illegible]7.	3[illegible]3.	348.	357.

DIRECT OPERATING COST - [illegible] UTILIZATION(HR)=2500. DEPRECIATION PERIOD(YR)=10. LABOR RATE($/HR)= 7.00
AIRFRAME COST ($/LB)= [illegible] ENGINE COST ($/HP)= [illegible] INSURANCE RATE=[illegible] FUEL COST (CENTS/GAL)= 18.0
DOC=1.[illegible]2+[illegible].C273*SL $/SEAT-TRIP (SL= 25.,500.)
HOP LENGTHS 50+150+ 0+ 0+ 0=250 100+200+ 0+ 0+ 0=300 200+200+ 0+ 0+ 0=400

STAGE LENGTH	25.	50.	75.	100.	150.	[illegible]	[illegible]	401.	500.	200.	300.	400.
NO. CYCL S/STARTS	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	2/1	2/1	2/1
FLIGHT CREW	[illegible]	[illegible]	0.411	0.374	[illegible].334	[illegible]	[illegible]	0.274	0.266	0.397	0.342	0.318
FUEL & OIL	[illegible]	[illegible]	0.179	0.1[illegible]7	0.178	[illegible]	[illegible]	0.165	0.163	0.187	0.178	0.174
HULL INSURANCE	[illegible]	[illegible]	0.247	0.225	0.2[illegible]1	[illegible]	[illegible]	0.165	0.160	0.224	0.199	0.186
TOTAL FLIGHT OPS	1.3[illegible]1	[illegible]	0.857	0.777	0.713	[illegible]	[illegible]	0.604	0.590	0.797	0.719	0.678
LABOR AIRFRAME	[illegible]	[illegible]	0.272	0.2[illegible]	0.197	0.176	0.1[illegible]	0.144	0.139	0.232	0.194	0.175
MATERIAL AIRFRAME	0.314	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.047	[illegible]	[illegible]	[illegible]	[illegible]
LABOR ENGINES	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.041	[illegible]	[illegible]	[illegible]	0.056
MATERIAL ENGINES	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.052	[illegible]	0.117	[illegible]	[illegible]
MAT. BURDEN	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.242	0.229	0.416	[illegible]	[illegible]
TOTAL MAINTENANCE	[illegible]	[illegible]	1.171	[illegible]	[illegible]	[illegible]	[illegible]	0.526	0.495	0.934	0.753	[illegible]
DEPRECIATION	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible].473	0.461	0.642	[illegible].573	[illegible].536
TOTAL DIRECT OPERATING [illegible]												
$/AIRCRAFT MILE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1.[illegible]	1.545	[illegible].374	[illegible]	1.374
$/FLIGHT HOUR	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible].7	[illegible]7.5	[illegible]	[illegible]8.5	537.7	575.8
$/SEAT MILE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.0475	0.0[illegible]	0.0375
$/SEAT-TRIP	2.5[illegible]	[illegible]	[illegible].11	[illegible]	[illegible]	[illegible]	1[illegible]	12.12	15.45	9.49	12.27	14.39

DEPARTURE

TIME HISTORY AT 500 FT SIDELINE

TIME=	1.5	4.5	7.5	10.5	13.5	16.5	19.5	22.5	25.5	28.5	31.5	34.5	37.5	40.5	43.5
PNL =	83.0	83.6	84.2	86.2	88.4	89.2	88.7	86.8	84.0	80.7	76.6	72.3	67.8	64.2	62.1

ARRIVAL

TIME HISTORY AT 500 FT SIDELINE

TIME=	397.5	400.5	403.5	406.5	409.5	412.5	415.5	418.5	421.5	424.5	427.5	430.5	433.5	[illegible]
PNL =	65.6	67.2	69.3	71.8	74.5	77.3	80.2	83.7	85.5	84.2	[illegible]	82.9	82.2	[illegible]

C-80-50

DEPARTURE PATH TO 10,000 FT MSL

MAX FUSE ANGLE=20. OBSTACLE CLEAR ANGLE=60. OBSTACLE HEIGHT=100. MAX ACCEL ROTATION RATE=20. ACCEL BUILDUP TIME= 5.

TIME SEC	DIST FT	ALT FT	VEL FPS	ACC G	GAM DEG	THRUST LB	LWGD LB	LWCI LB	DWSI LB	LWGI LB	DFUST LB	ALP DEG	THE DEG	AWO DEG	ALV DEG	LAMDA	MU	CT	POWER HP
OBSTACLE CLEARANCE																			
0.0	0.	0.	0.	0.0	60.0	46415.	0.	-59.	0.	1242.	0.	30.1	2.5	-57.1	30.5	0.0639	0.0	0.0082	4889.
8.6	11.	15.	5.	0.036	60.0	45270.	-2.	-521.	1.	722.	4.	29.7	24.6	-35.4	27.7	0.0683	0.0041	0.0085	5258.
10.5	18.	31.	10.	0.124	60.0	51734.	-9.	-473.	5.	635.	18.	27.5	24.6	-35.4	24.2	0.0747	0.0076	0.0090	6768.
11.5	24.	42.	15.	0.192	60.0	53523.	-21.	-753.	10.	591.	40.	26.0	24.6	-35.4	21.7	0.0804	0.0109	0.0095	6739.
12.4	32.	56.	20.	0.142	60.0	51508.	-37.	-755.	14.	541.	71.	27.1	24.6	-35.4	20.[illegible]	0.0835	0.0145	0.0091	6739.
13.7	47.	81.	25.	0.096	60.0	49721.	-58.	-756.	23.	516.	112.	28.2	24.6	-35.4	19.2	0.0865	0.0138	0.0088	6739.
14.3	58.	100.	26.	0.051	60.0	47986.	-34.	-762.	41.	496.	161.	29.3	24.6	-35.4	18.4	0.0896	0.0233	0.0085	6739.
ACCELERATION AND CONVERSION																			
16.5	93.	153.	33.	0.166	53.5	46451.	-117.	-550.	35.	323.	140.	28.1	24.6	-28.5	17.5	0.0932	0.0257	0.0086	6739.
17.5	125.	191.	38.	0.167	44.4	46562.	-199.	-1255.	33.	245.	110.	37.5	24.6	-19.8	21.5	0.0929	0.0376	0.0086	6739.
19.3	165.	229.	44.	0.158	37.5	46173.	-314.	-1534.	41.	201.	85.	45.2	24.6	-13.0	23.8	0.0924	0.0502	0.0087	6739.
20.8	226.	268.	51.	0.156	31.3	46514.	-212.	-1930.	37.	177.	67.	50.6	24.6	-7.7	24.2	0.0921	0.0625	0.0097	6739.
22.2	293.	308.	56.	0.158	28.2	46966.	76.	-2166.	36.	166.	55.	54.4	24.6	-3.6	23.5	0.0919	0.0744	0.0087	6739.
23.6	368.	345.	63.	0.170	25.0	47444.	441.	-2345.	43.	161.	48.	56.9	24.6	-0.4	22.2	0.0916	0.0864	0.0087	6739.
25.0	451.	382.	70.	0.169	22.4	47005.	891.	-2654.	59.	167.	49.	59.3	24.6	2.2	20.5	0.0915	0.0985	0.0087	6739.
26.4	545.	418.	77.	0.169	20.3	46531.	1401.	-2551.	82.	175.	55.	61.2	24.6	4.3	18.8	0.0915	0.1104	0.0087	6739.
27.8	652.	456.	84.	0.160	18.5	46771.	2032.	-3368.	113.	187.	67.	63.2	24.6	6.1	17.0	0.0917	0.1224	0.0087	6739.
29.2	765.	494.	91.	0.165	17.0	45317.	2686.	-2051.	153.	119.	85.	62.5	24.6	7.6	14.8	0.0944	0.1331	0.0084	6739.
30.6	897.	531.	98.	0.160	15.7	43536.	3454.	-677.	201.	87.	110.	62.4	24.6	8.8	12.7	0.0980	0.1431	0.0081	6739.
32.1	1040.	570.	105.	0.157	14.6	41650.	4306.	800.	256.	90.	141.	61.7	24.6	9.5	10.5	0.1023	0.1531	0.0077	6739.
33.6	1199.	610.	112.	0.149	13.7	39521.	5242.	2388.	323.	123.	177.	61.1	24.6	10.9	9.2	0.1077	0.1625	0.0073	6739.
35.2	1377.	652.	120.	0.147	12.8	37254.	6263.	4066.	392.	185.	220.	55.6	24.6	11.8	7.8	0.1141	0.1715	0.0069	6739.
36.8	1575.	656.	127.	0.135	12.1	34663.	7376.	5887.	473.	275.	269.	58.4	24.6	12.5	6.4	0.1224	0.1794	0.0064	6739.
38.6	1799.	742.	134.	0.129	11.4	32016.	8562.	7813.	562.	389.	325.	56.2	24.6	13.2	5.3	0.1324	0.1863	0.0059	6739.
40.5	2057.	793.	142.	0.115	10.8	29365.	9676.	9602.	639.	505.	375.	54.6	24.3	13.5	4.3	0.1440	0.1919	0.0054	6739.
42.6	2358.	849.	149.	0.105	10.3	27142.	10814.	11103.	651.	601.	415.	52.9	23.8	13.5	3.6	0.1556	0.1976	0.0050	6739.
44.9	2701.	91[illegible].	156.	0.098	9.8	24901.	11660.	12678.	756.	705.	457.	50.4	23.3	13.5	2.9	0.1695	0.2012	0.0046	6739.
47.4	3101.	977.	164.	0.085	9.3	22355.	12724.	14385.	822.	822.	501.	47.6	22.9	13.5	2.3	0.1885	0.2000	0.0041	6739.
50.2	3567.	1052.	171.	0.080	8.9	20285.	13835.	16141.	888.	943.	547.	43.3	22.4	13.5	1.8	0.2135	0.1944	0.0037	6739.
53.2	4086.	1131.	178.	0.076	8.6	17634.	14994.	17587.	957.	1072.	595.	37.4	22.1	13.5	1.3	0.2379	0.1801	0.0033	6739.
56.2	4625.	1212.	186.	0.076	8.2	15785.	16200.	19918.	1029.	1203.	645.	29.5	21.7	13.5	0.9	0.2702	0.1523	0.0029	6739.
59.3	5195.	1293.	193.	0.077	7.9	14125.	17454.	21526.	1104.	1351.	698.	19.1	21.4	13.5	0.5	0.3044	0.1055	0.0026	6739.
62.3	5751.	1374.	201.	0.076	7.6	13030.	18756.	23099.	1181.	1500.	752.	6.3	21.1	13.5	0.1	0.3320	0.0372	0.0024	6739.
65.5	6438.	1459.	208.	0.065	7.3	12536.	15735.	25382.	1219.	1568.	785.	-3.3	21.6	13.2	0.0	0.3452	-0.0233	0.0023	6739.
67.8	6913.	1519.	213.	0.069	7.2	12243.	15763.	25353.	1177.	1510.	767.	-3.2	19.8	12.6	0.0	0.3536	-0.0200	0.0023	6739.
AIRPLANE MODE CLIMB TO 10,000 FT																			
81.6	5823.	1911.	213.	0.0	15.0	14845.													
235.6	43876.	10000.	242.	0.0	12.6	13050.													

THE NOISE ANNOYANCE IS 0.22282D+06   ONE POINT IN 1 OF THE GRID WAS USED

AT 500. FT. SIDELINE AND 0. FT. FORWARD, NOISE= 91.1 EPNDB
AT 1000. FT. SIDELINE AND 0. FT. FORWARD, NOISE= 82.8 EPNDB
AT 10000. FT. SIDELINE AND 0. FT. FORWARD, NOISE= 0.0 EPNDB
AT 20000. FT. SIDELINE AND 0. FT. FORWARD, NOISE= 0.0 EPNDB
AT 0. FT. SIDELINE AND -21000. FT. FORWARD, NOISE= 0.0 EPNDB
AT 0. FT. SIDELINE AND -5000. FT. FORWARD, NOISE= 0.0 EPNDB
AT 0. FT. SIDELINE AND 6000. FT. FORWARD, NOISE= 74.4 EPNDB
AT 0. FT. SIDELINE AND 30000. FT. FORWARD, NOISE= 0.0 EPNDB
AT 0. FT. SIDELINE AND 51000. FT. FORWARD, NOISE= 0.0 EPNDB
AT 0. FT. SIDELINE AND 2500. FT. FORWARD, NOISE= 83.2 EPNDB

Information Processing Center

ORIGINAL PAGE IS
OF POOR QUALITY

D-80-50 DEPARTURE

68.4	68.2	66.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
74.[illegible]	73.7	70.9	70.2	64.2	0.0	0.0	0.0	0.0	[illegible]
76.7	76.0	75.0	74.1	71.7	67.8	0.0	0.0	0.0	0.0
79.5	79.0	78.1	76.2	74.9	71.8	0.0	0.0	0.0	0.0
75.2	0.0	0.0	0.0	76.4	74.7	71.4	0.0	0.0	0.0
85.2	83.4	78.1	0.0	78.7	75.8	72.1	64.8	0.0	0.0
		83.8	[illegible]	79.9	77.1	74.6	71.2	0.0	0.0
		86.8	80.5	80.9	78.0	75.4	71.8	0.0	0.0
		88.1	82.3	81.5	78.7	75.7	72.8	0.0	0.0
		87.5	82.7	81.6	78.6	75.9	72.4	67.9	0.0
94.1	90.7	86.5	81.8	81.4	78.4	75.6	72.4	65.1	0.0
91.4	88.8	85.7	82.2	81.0	78.5	75.9	72.9	65.0	0.0
89.8	88.[illegible]	85.5	82.9	80.3	77.8	75.1	72.0	0.0	0.0
88.1	86.5	84.4	82.0	79.8	77.3	74.1	70.[illegible]	0.0	0.0
86.4	85.1	83.2	80.5	78.8	76.0	73.5	69.9	0.0	0.0
85.1	83.7	81.9	80.0	77.5	75.2	72.1	0.0	0.0	0.0
83.7	82.1	80.6	78.5	76.3	74.4	70.0	0.0	0.0	0.0
82.2	81.[illegible]	79.4	77.6	75.7	72.3	0.0	0.0	0.0	0.0
81.5	80.0	79.3	76.5	74.2	71.7	0.0	0.0	0.0	0.0
80.2	79.0	77.5	75.5	72.5	70.5	0.0	0.0	0.0	0.0
80.1	78.5	76.5	74.7	72.9	69.3	0.0	0.0	0.0	0.0
79.0	77.0	76.1	73.9	72.0	66.8	0.0	0.0	0.0	0.0
79.2	77.5	75.8	74.1	71.7	68.7	0.0	0.0	0.0	0.0
78.2	76.8	75.1	73.3	71.5	68.4	0.0	0.0	0.0	0.0
76.4	76.0	75.1	72.5	70.0	66.2	0.0	0.0	0.0	0.0
77.2	75.5	74.7	72.5	69.5	65.2	0.0	0.0	0.0	0.0
77.4	75.[illegible]	73.5	71.[illegible]	69.2	64.8	0.0	0.0	0.0	0.0
76.6	75.2	73.6	71.4	68.6	0.0	0.0	0.0	0.0	0.0
75.4	73.7	71.4	69.7	65.3	0.0	0.0	0.0	0.0	0.0
75.2	73.6	71.4	66.4	0.0	0.0	0.0	0.0	0.0	0.0
73.7	73.0	71.8	65.1	0.0	0.0	0.0	0.0	0.0	0.0
74.4	73.1	71.5	68.3	0.0	0.0	0.0	0.0	0.0	0.0

D-80-50 ARRIVAL

65.7	65.6	65.3	65.0	0.0	0.0	0.0	0.0	0.0	0.0
70.9	69.5	69.1	68.0	65.7	65.0	0.0	0.0	0.0	0.0
74.0	73.8	72.7	71.1	69.2	66.1	65.2	0.0	0.0	0.0
76.4	75.8	74.8	74.0	72.4	69.4	66.1	65.0	0.0	0.0
78.4	78.0	77.2	75.8	74.2	70.4	69.0	65.6	0.0	0.0
80.7	80.1	79.0	77.6	76.1	73.7	69.7	66.0	0.0	0.0
81.5	79.4	75.6	0.0	77.1	74.4	70.1	66.2	0.0	0.0
87.1	85.3	80.0	79.0	77.9	75.2	70.2	66.0	0.0	0.0
		84.1	75.5	76.4	75.2	69.9	65.5	0.0	0.0
		84.9	0.0	78.3	75.1	69.1	0.0	0.0	0.0
		85.9	0.0	78.7	75.5	68.9	0.0	0.0	0.0
		86.4	76.2	79.9	76.8	72.3	65.1	0.0	0.0
97.7	91.1	85.9	75.5	80.3	77.5	73.9	66.5	0.0	0.0
96.4	90.4	84.0	0.0	80.1	77.5	72.5	66.9	65.2	0.0
95.7	90.8	85.9	82.6	80.0	77.3	71.2	66.6	65.2	0.0
94.8	90.8	86.0	82.0	80.1	77.0	72.6	66.0	64.8	0.0
94.0	90.6	86.0	82.8	79.6	76.9	72.5	65.2	0.0	0.0
93.1	90.0	85.9	82.3	79.5	76.9	72.6	0.0	0.0	0.0
92.3	89.6	85.7	82.5	79.0	76.9	73.5	0.0	0.0	0.0
91.6	89.1	85.7	82.6	79.7	76.8	73.8	0.0	0.0	0.0
91.0	88.6	85.5	82.6	79.9	77.4	74.5	0.0	0.0	0.0
90.3	88.2	85.4	82.7	80.2	77.0	74.8	69.7	0.0	0.0
89.0	87.9	85.3	82.3	80.2	77.7	75.0	67.9	0.0	0.0
88.9	87.4	85.1	82.7	80.3	78.1	75.6	71.2	0.0	0.0
88.3	87.1	84.9	82.7	80.4	78.2	75.7	71.4	0.0	0.0
87.8	86.7	84.8	82.6	80.5	78.3	75.8	72.4	0.0	0.0
87.3	86.4	84.6	82.5	80.4	78.3	75.9	72.5	0.0	0.0
86.8	86.0	84.3	82.4	80.4	78.4	76.0	72.6	0.0	0.0
86.3	85.7	84.1	82.3	80.5	78.4	76.0	73.4	0.0	0.0
85.9	85.3	83.9	82.1	80.4	78.4	76.1	73.4	0.0	0.0
85.5	84.9	83.7	82.1	80.2	78.3	76.4	73.5	0.0	0.0
85.1	84.6	83.4	81.9	80.1	78.5	76.4	73.5	0.0	0.0
84.8	84.3	83.2	81.8	80.1	78.4	76.4	73.5	0.0	0.0
84.4	84.0	83.0	81.5	80.0	78.2	76.0	73.5	0.0	0.0

S-SC-[illegible]

STAGE LENGTH (MI.)	[illegible]	[illegible]	75.	1[illegible]	15[illegible]	20[illegible]	300.	400.	500.
CRUISE ALTITUDE (FT.)	[illegible]	[illegible]	1[illegible] 1.	125[illegible]	1[illegible]	15[illegible]	1[illegible]	15[illegible]	15[illegible]
CRUISE SPEED (MPH)	2[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	323.	32[illegible]	32[illegible]
CRUISE L/D	11.14	11.[illegible]	11.[illegible]	12.41	1[illegible].14	13.14	13.14	13.14	13.14
CRUISE DISTANCE (MI.)	[illegible]	2[illegible]	[illegible].5	48.6	[illegible]8.2	13[illegible].2	236.2	328.2	433.2
BLOCK TIME (MIN.)	1[illegible]	1[illegible]	21.4	26.7	37.[illegible]	46.3	64.9	83.4	102.6
BLOCK FUEL (LB.)	2[illegible]	[illegible]	[illegible]	657.	[illegible]92.	12[illegible]	1[illegible]5.	2554.	3197.
BLOCK SPEED (MPH)	13[illegible]	[illegible]	[illegible]	2[illegible]	247.	[illegible]	277.	288.	294.

DIRECT OPERATING COST - [illegible] UTILIZATION(HR)=2000. DEPRECIATION PERIOD(YR)=1[illegible]. LABOR RATE($/HR)= 7.0)
AIRFRAME COST ($/LB)= 3[illegible] ENGINE COST ($/HP)= 6[illegible] INSURANCE RATE=0.04[illegible] FUEL COST (CENTS/GAL)= 18.0
[illegible]=1.5[illegible]+0.0[illegible]SL $/SEAT-TRIP ([illegible]= 25[illegible])
HCF LENGTHS [illegible]+15[illegible] [illegible] [illegible]=2[illegible] 1[illegible]+2[illegible] [illegible] [illegible] [illegible]=3 [illegible] 2[illegible]+2 [illegible] [illegible] [illegible]=4[illegible])

STAGE LENGTH	[illegible]	[illegible]	75.	[illegible]	150.	[illegible]	[illegible]	400.	500.	200.	300.	300.
NO. CYCLES/STARTS	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	2/1	2/1	2/1
FLIGHT CREW	[illegible].75	[illegible].435	[illegible].441	0.414	0.392	[illegible].359	0.3[illegible]	0.323	0.316	0.423	0.387	0.366
FUEL & OIL	0.[illegible]17	[illegible].253	0.210	0.19[illegible]	0.1[illegible]	0.1[illegible]	0.177	0.174	0.172	0.201	0.185	0.181
HULL INSURANCE	0.[illegible]11	[illegible].[illegible]67	0.254	0.213	[illegible].28[illegible]	.271	[illegible]	0.244	0.239	0.309	0.285	0.271
TOTAL FLIGHT OPS	1.[illegible]	1.1[illegible]	[illegible].9[illegible]	0.921	[illegible].855	[illegible].81[illegible]	[illegible].7[illegible]	0.741	0.727	0.933	0.859	0.818
LABOR AIRFRAME	[illegible]	[illegible].37[illegible]	[illegible].312	[illegible].278	[illegible].24[illegible]	[illegible].21[illegible]	[illegible]	[illegible].19[illegible]	0.177	[illegible].272	0.236	0.217
MATERIAL AIRFRAME	[illegible].[illegible]4	.1[illegible]	[illegible].1[illegible]	0.1[illegible]9	[illegible].[illegible]1	[illegible]	[illegible].[illegible]71	[illegible].[illegible]66	0.062	0.104	[illegible].[illegible]88	0.[illegible]79
LABOR ENGINES	0.[illegible]	[illegible].170	0.125	0.10[illegible]	0.07[illegible]	0.06[illegible]	0.05[illegible]	0.047	0.043	0.092	0.072	0.061
MATERIAL ENGINES	0.437	0.234	0.168	0.1[illegible]5	0.1[illegible]1	[illegible]	[illegible]	[illegible].[illegible]56	[illegible].[illegible]51	0.12[illegible]	0.091	0.[illegible]76
MAT. BURDEN	1.1[illegible]	[illegible].71[illegible]	0.569	0.493	0.424	[illegible].[illegible]3	0.372	0.3[illegible]	0.256	0.474	0.400	0.361
TOTAL MAINTENANCE	2.[illegible]6	1.64[illegible]	1.299	1.116	0.924	0.[illegible]15	[illegible].7[illegible]	0.652	0.613	1.062	0.887	0.794
DEPRECIATION	1.[illegible]	1.[illegible]5	[illegible].[illegible]1	1.892	[illegible].523	[illegible].172	[illegible].721	[illegible].496	[illegible].681	1.879	0.812	0.772
TOTAL DIRECT OPERATING COST												
$/ AIRCRAFT MILE	5.[illegible]	3.[illegible]5[illegible]	[illegible].235	2.929	2.6[illegible]3	2.398	2.1[illegible]	2.[illegible]	2.027	2.674	2.557	2.334
$/FLIGHT HOUR	7[illegible]1.2	[illegible]27.3	[illegible].8	657.1	632.6	621.3	[illegible]	[illegible]	596.[illegible]	654.5	629.9	617.7
$/SEAT MILE	0.1151	0.0[illegible]6[illegible]	0.0647	0.0586	0.0521	0.04[illegible]	0.0[illegible]	0.0413	0.0405	0.0575	0.0511	0.0477
$/SEAT-TRIP	2.[illegible]	[illegible].8[illegible]	4.65	5.86	7.81	[illegible].5[illegible]	13.1[illegible]	16.71	20.27	11.5[illegible]	15.34	19.07

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5-60-50

DEPARTURE PATH TO 10,000 FT MSL

MAX FUSE ANGLE=20. OBSTACLE CLEAR ANGLE=60. OBSTACLE HEIGHT=100. MAX ACCEL ROTATION RATE=20. ACCEL BUILDUP TIME= 5.

TIME SEC	DIST FT	ALT FT	VEL FPS	ACC G	GAM DEG	THRUST LB	LWGO LB	LWCI LB	DWGO LB	DWGI LB	DELST LB	ALP DEG	THE DEG	AND DEG	ALV DEG	LAMDA	MU	CT	POWER HP
OBSTACLE CLEARANCE																			
0.0	0.	0.	0.	0.0	60.0	54966.	0.	-67.	0.	1479.	0.	30.1	2.9	-57.1	30.5	0.0905	0.0	0.0104	[illegible]
8.6	11.	19.	5.	0.036	60.0	55595.	-3.	-671.	2.	795.	5.	29.6	24.6	-35.4	27.4	0.0975	[illegible]	0.0167	5341.
10.5	18.	31.	10.	0.124	60.0	62133.	-13.	-788.	6.	715.	13.	27.5	24.6	-35.4	23.7	0.1073	[illegible]	0.0181	6192.
11.5	24.	42.	15.	0.201	60.0	63953.	-28.	-853.	19.	669.	41.	25.8	24.6	-35.4	20.9	0.1166	0.0172	0.0191	70[illegible]
12.4	32.	55.	20.	0.153	60.0	61585.	-50.	-892.	25.	636.	72.	26.8	24.6	-35.4	21.0	0.1208	0.0238	0.0185	[illegible]1.
13.6	46.	79.	25.	0.098	60.0	59335.	-79.	-889.	35.	598.	113.	28.1	24.6	-35.4	19.0	0.1261	0.0319	0.0177	7011.
14.2	59.	100.	26.	0.048	60.0	56705.	-113.	-902.	56.	573.	162.	29.4	24.6	-35.4	17.9	0.1312	0.0386	0.0170	7011.
ACCELERATION AND CONVERSION																			
16.6	97.	160.	33.	0.131	53.9	54815.	-153.	-1107.	53.	384.	141.	29.6	24.6	-27.3	17.0	0.1365	[illegible]	0.0172	7011.
18.2	133.	203.	37.	0.137	45.2	55027.	-253.	-1453.	52.	293.	113.	38.2	24.6	-20.6	20.4	0.1356	0.0575	0.0172	7011.
19.8	181.	245.	42.	0.133	38.5	55297.	-391.	-1781.	54.	247.	90.	45.6	24.6	-13.9	22.2	0.1348	0.0762	0.0173	7011.
21.5	242.	293.	48.	0.129	33.4	55542.	-359.	-2100.	52.	219.	73.	51.0	24.6	-8.8	22.6	0.1341	0.0969	0.017[illegible]	7011.
23.1	311.	332.	54.	0.142	29.3	55638.	-18.	-2441.	48.	[illegible]	61.	54.2	24.6	-4.7	21.7	0.1335	0.1143	0.0174	[illegible]
24.6	387.	372.	60.	0.144	26.1	55730.	407.	-2798.	53.	[illegible]	55.	57.2	24.6	-1.5	20.4	0.1331	0.1321	0.0175	7011.
26.1	474.	412.	66.	0.144	23.4	55721.	921.	-3189.	67.	208.	54.	59.6	24.6	1.2	18.8	0.1329	0.1590	0.0175	7011.
27.6	571.	452.	73.	0.142	21.2	55660.	1529.	-3623.	93.	213.	59.	61.6	24.6	3.3	17.2	0.1327	0.1685	0.0174	7011.
29.2	684.	493.	79.	0.131	19.4	55259.	2229.	-3797.	127.	216.	69.	63.5	24.6	5.2	15.5	0.1333	0.1856	0.0173	7011.
30.8	805.	534.	86.	0.146	17.9	53561.	3026.	-2226.	171.	143.	84.	62.5	24.6	6.7	13.4	0.1371	0.2016	0.0168	7011.
32.3	939.	576.	93.	0.129	16.6	51282.	3521.	-483.	224.	113.	135.	63.0	24.6	8.6	11.4	0.1429	0.2163	0.0161	7011.
33.9	1088.	618.	99.	0.141	15.4	49149.	4914.	1283.	296.	123.	132.	61.5	24.6	9.2	9.8	0.1496	0.2316	0.0154	7011.
35.7	1257.	664.	106.	0.119	14.4	46132.	6000.	3236.	353.	171.	104.	62.4	24.6	10.2	8.2	0.1579	0.2451	0.0145	7011.
37.6	1461.	714.	113.	0.115	13.5	43471.	7197.	5252.	440.	251.	201.	60.4	24.6	11.0	6.9	0.1673	0.2598	0.0136	7011.
39.5	1674.	764.	119.	0.114	12.8	40500.	8439.	7567.	531.	370.	244.	58.5	24.6	11.8	5.8	0.1768	0.2711	0.0127	7011.
41.5	1913.	817.	126.	0.112	12.1	[illegible]	[illegible]	9983.	622.	513.	292.	56.8	24.6	12.5	4.7	0.1949	[illegible]	0.0116	7011.
43.7	2234.	877.	133.	0.087	11.4	37382.	11372.	12587.	743.	678.	346.	54.6	24.6	13.1	3.7	0.2161	0.2863	0.0105	7011.
46.3	2552.	946.	140.	0.075	10.9	[illegible]	12723.	14565.	842.	847.	397.	51.5	24.4	13.5	2.9	0.2395	[illegible]	[illegible]	7011.
49.2	2955.	1022.	147.	0.071	10.4	27782.	13986.	16664.	914.	982.	436.	48.7	23.9	13.5	2.3	0.2641	0.2914	0.0085	7011.
52.4	3415.	1104.	152.	0.066	9.9	24438.	15245.	19105.	1093.	1127.	476.	44.7	23.4	13.5	1.8	0.2945	0.2361	0.0077	7011.
55.7	3933.	1192.	160.	0.063	9.5	21174.	16555.	21326.	1067.	1201.	521.	39.3	23.0	13.5	1.3	0.3327	0.2795	0.0068	7011.
59.1	4481.	1282.	167.	0.064	9.1	19268.	17930.	23655.	1159.	1444.	567.	31.5	22.6	13.5	0.9	0.3781	0.2349	0.0060	7011.
62.4	5037.	1369.	174.	0.067	8.7	17181.	19356.	26613.	1233.	1715.	615.	22.1	22.2	13.5	0.5	0.4294	0.1744	0.0053	7011.
65.5	[illegible]	1453.	181.	0.069	8.4	15728.	[illegible]	28869.	1321.	1792.	[illegible]	10.0	21.9	13.5	0.2	0.4739	[illegible]	[illegible]	[illegible]
68.3	6155.	1540.	188.	0.062	8.1	14398.	22377.	30906.	1412.	[illegible]	715.	-2.8	21.6	13.5	0.1	0.4984	-0.0236	0.0047	7011.
72.3	6957.	1632.	195.	0.061	7.8	14480.	22462.	31817.	1342.	1944.	699.	-3.4	20.4	12.6	0.0	0.5161	-0.0251	0.0045	7011.
75.1	[illegible]	[illegible]	[illegible]	[illegible]	7.6	[illegible]	22496.	30983.	1290.	[illegible]	689.	-3.3	19.5	11.4	0.0	0.5298	-0.0315	0.0044	7011.
AIRPLANE MODE CLIMB TO 10,000 FT																			
87.1	9787.	1995.	[illegible]	0.0	10.8	10298.													
261.3	46068.	10000.	227.	0.0	11.7	14451.													

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S-EC-5C

ARRIVAL PATH FROM 10,000 FT MSL
TERMINAL AREA SPEED = 200. KIAS, FINAL APPROACH SPEED = 60. KIAS, FINAL APPROACH SLOPE = 8.0 DEG, ACCEL BUILDUP TIME = 5. SEC
MAX CONNARC FUSE ANGLE =10.0 DEG

TIME SEC	DIST FT	ALT FT	VEL FPS	ACC G	GAM DEG	THRUST LB	LWG LB	RWG LB	MWAC LB	DIG LB	DFUST LB	ALP DEG	THE DEG	AWD DEG	ALV DEG	LAMBDA	MU	CT	POWER HP
AIRPLANE MODE DESCENT																			
0.0	0.	10000.	491.	0.0	-5.4	0.													
172.0	75825.	3213.	441.	0.0	-5.4	0.													
182.3	84357.	3000.	441.	0.0	0.0	0.													
AIRPLANE MODE DECELERATION																			
194.0	89355.	3000.	423.	-0.054	0.0	0.													
199.5	51654.	3000.	406.	-0.104	0.0	0.													
204.5	53835.	3000.	388.	-0.120	0.0	0.													
208.7	55249.	3000.	371.	-0.139	0.0	0.													
216.6	58113.	3000.	353.	0.0	0.0	7561.													
AIRPLANE MODE DESCENT																			
231.2	103262.	2656.	353.	0.0	-7.7	0.													
252.2	110528.	1764.	345.	0.0	-7.7	0.													
263.7	114468.	1500.	345.	0.0	0.0	0.													
DECELERATION AND CONVERSION																			
265.0	116271.	1500.	328.	-0.200	0.0	1674.						0.0							
271.7	117126.	1500.	311.	-0.200	0.0	2152.						0.0							
274.4	117935.	1500.	293.	-0.200	0.0	2415.						0.0							
277.1	118658.	1500.	276.	-0.200	0.0	3782.	48568.	9451.	793.	2059.	1127.	19.6	-1.1	-1.1	0.0	0.6851	0.2440	0.0012	2958.
279.7	119414.	1500.	259.	-0.200	0.0	7234.	44953.	9689.	2311.	1810.	990.	40.5	-1.1	-1.1	0.2	0.5196	0.4423	0.0023	4378.
282.4	120084.	1500.	242.	-0.200	0.0	11353.	40305.	9653.	3202.	1576.	863.	55.7	-1.1	-1.1	0.4	0.3609	0.5233	0.0036	4898.
285.1	120708.	1500.	224.	-0.200	0.0	16125.	35160.	9361.	3425.	1359.	744.	67.3	-1.1	-1.1	0.8	0.2314	0.5446	0.0051	4620.
287.8	121286.	1500.	207.	-0.200	0.0	21138.	29656.	8838.	3216.	1158.	634.	75.8	-1.1	-1.1	1.2	0.1385	0.5285	0.0067	3970.
290.5	121818.	1500.	190.	-0.200	0.0	26454.	24135.	8114.	2315.	973.	533.	82.0	-1.1	-1.1	1.9	0.0777	0.4946	0.0083	3040.
293.1	122303.	1500.	173.	-0.200	0.0	31790.	18786.	7223.	2352.	804.	440.	86.4	-1.1	-1.1	2.8	0.1391	0.4532	0.0100	2232.
295.8	122742.	1500.	155.	-0.200	0.0	36906.	13730.	6157.	1920.	651.	356.	89.8	-1.1	-1.1	4.0	0.0159	0.4056	0.0116	1557.
298.5	123135.	1500.	138.	-0.201	0.0	41704.	8593.	5062.	1516.	515.	282.	92.4	-1.1	-1.1	5.7	0.0059	0.3630	0.0131	1168.
301.3	123499.	1500.	121.	-0.180	0.0	45579.	4779.	3820.	1155.	394.	216.	93.2	-1.1	-1.1	9.2	0.0275	0.3175	0.0144	1168.
307.2	124167.	1500.	104.	0.0	0.0	48429.	2383.	2846.	846.	290.	158.	84.2	-1.1	-1.1	11.1	0.0546	0.2711	0.0152	3068.
HELICOPTER MODE FINAL APPROACH																			
311.8	124631.	1468.	104.	0.0	-8.0	44326.	5885.	3221.	852.	290.	122.	92.3	-5.4	2.6	10.7	0.0147	0.2722	0.0135	1358.
367.3	130265.	676.	101.	0.0	-8.0	44325.	5896.	3222.	852.	290.	122.	92.3	-5.4	2.6	10.7	0.0144	0.2663	0.0133	1377.
DECELERATION TO HOVER																			
406.4	133657.	171.	84.	-0.027	-8.0	47672.	2958.	2059.	585.	201.	85.	95.9	-5.4	2.6	16.6	0.0112	0.2211	0.0143	1221.
416.3	134599.	67.	68.	-0.079	-8.0	49375.	1836.	1405.	369.	129.	54.	100.3	-5.4	2.6	27.0	0.0121	0.1751	0.0148	1221.
420.0	134819.	36.	51.	-0.200	-8.0	52035.	967.	853.	195.	72.	31.	117.9	-5.4	2.6	51.2	0.0200	0.1269	0.0156	1561.
422.8	134928.	20.	34.	-0.200	-8.0	53108.	261.	1015.	90.	32.	14.	108.2	-5.4	2.6	75.5	0.0525	0.0844	0.0159	3035.
425.3	134994.	11.	17.	-0.200	-8.0	52856.	-55.	1267.	28.	3.	3.	108.4	-5.4	2.6	94.2	0.0775	0.0422	0.0161	4210.
430.5	135038.	5.	0.	0.0	-8.0	51738.	-158.	1246.	7.	0.	0.	97.9	-5.4	2.6	97.8	0.0880	0.0	0.0155	4531.
LAND																			
435.5	135038.	0.	0.	0.0	-90.0	51750.	41.	-1260.	7.	0.	0.	-180.0	2.9	92.9	180.0	0.0881	0.0	0.0155	4533.

TOVER EXAMPLE

DESIGN ITERATIONS: 6

OVERALL	
GROSS WEIGHT (LB)	431?5.
EMPTY WEIGHT (LB)	29113.
FUEL WEIGHT (LB)	3344.
PAYLOAD (LB)	10150.
CRUISE SPEED (MPH)	423.
L/D CRUISE	10.9?
*RANGE (STAT MI)	500.
*PASSENGER SEATS	50.
*CARGO (LB)	0.

ROTORS	
*DISC LOADING (PSF)	10.[illegible]
RADIUS (FT)	26.2
SOLIDITY	0.093
BLADE CHORD (FT)	2.56
TOTAL BLADES	6
*CT/SIG HOVER	0.120
*PROFILE DRAG COEFF	0.010
% DOWNLOAD	9.5
*EFFICIENCY HOVER	0.85
* CONVER	0.93
CRUISE	0.76
HEL MODE WEIGHT (LB)	3724.
AIRPLANE WEIGHT (LB)	3237.
*TIP SPEED HOVER	700.
* CRUISE	570.
*FUSELAGE CLEARANCE (FT)	1.0
*MAX HEL MODE ADV RATIO	0.40

* INDICATES INPUT VARIABLE

POWERPLANT	
INST NORMAL PWR (HP)	8613.
*NUMBER OF ENGINES	2.
*BYPASS FACTOR HEL MODE	1.90
*% RATED EMRG HVR	140.
* CONV + CLIMB	120.
* CRUISE	90.
INST PWR EMRG HVR (HP)	8613.
CONVER (HP)	6532.
CRUISE (HP)	8567.
*SFC (LB/HP HR)	0.405

DRIVE SYSTEM	
*EFFICIENCY	0.97
HEL MODE WEIGHT (LB)	3841.
AIRPLANE WEIGHT (LB)	4499.

WING	
AREA (SF)	514.
*LOADING (PSF)	84.0
ASPECT RATIO	8.03
SPAN (FT)	64.4
MEAN CHORD (FT)	7.98
*THICKNESS/CHORD RATIO	0.210
*TAPER RATIO	0.70
SWEEP (DEG)	-5.3
CRUISE LIFT COEFF	0.29
MAX LIFT COEFF CONVER	0.94
*MAX LIFT COEFF CLEAN	1.40
*FLAP AREA/WING AREA	0.25
CLIMB SPD/CONVER SPD	0.85

FUSELAGE	
*LENGTH (FT)	80.0
*DIAMETER (FT)	10.0
*DRAG FACTOR	1.00

FLAT PLATE AREAS (SF)	
WING PROFILE	3.44
FUSELAGE	5.27
EMPENNAGE	2.06
TOTAL PROFILE	13.03
WING INDUCED	1.95

COMPONENT WEIGHTS (LB)	
ROTORS	3724.
DRIVE SYSTEM	4498.
POWERPLANT	1571.
NACELLES	212.
FUEL SYSTEM	311.
WING	3597.
FUSELAGE	5549.
EMPENNAGE	842.
LANDING GEAR	1295.
FLIGHT CONTROLS	1825.
HYDRAULICS	269.
ELECTRICAL	673.
INSTR+AVIONICS	703.
AIR CONDITIONING	1150.
FURNISHINGS	2500.
FLUIDS	216.
FLIGHT CREW	400.
CABIN CREW	150.

STRUCT TECHNOLOGY FACTORS	
*ROTOR	1.33
*TRANSMISSION	0.83
*AIRFRAME	0.78
*ENGINE (HP/LB)	8.50
*ENGINE INSTALLATION	1.55

DESIGN MISSION	
*FIELD ELEVATION (FT)	0.
SOUND SPEED HVR (FPS)	1117.
*STD DAY TEMP (DEG F)	59.
*EMERG HOVER ALT (FT)	2000.
*HOT DAY TEMP (DEG F)	95.
*CT/SIG MAX	0.150
*MAX ACCELERATION (G)	0.25
*DESIGN CRUISE (MPH)	420.
*CRUISE ALTITUDE (FT)	15000.
SOUND SPEED CRSE (FPS)	1058.
*MAX DECELERATION (G)	0.20
*STRUCT LOAD FACTOR	4.5
*FLIGHT CREW	2.
*CABIN CREW	1.
*ATC SPEED LIMIT	YES

ORIGINAL PAGE IS OF POOR QUALITY

THE NOISE ANNOYANCE IS 0.54916D 06 ONE POINT IN 1 OF THE GRID WAS USED

AT 500. FT. SIDELINE AND 0. FT. FORWARD, NOISE=102.8 EPNDB
AT 1000. FT. SIDELINE AND 0. FT. FORWARD, NOISE= 92.5 EPNDB
AT 10000. FT. SIDELINE AND 0. FT. FORWARD, NOISE= 65.6 EPNDB
AT 20000. FT. SIDELINE AND 0. FT. FORWARD, NOISE= 0.0 EPNDB
AT 0. FT. SIDELINE AND-20000. FT. FORWARD, NOISE= 0.0 EPNDB
AT 0. FT. SIDELINE AND -5000. FT. FORWARD, NOISE= 74.4 EPNDB
AT 0. FT. SIDELINE AND 6000. FT. FORWARD, NOISE= 72.1 EPNDB
AT 0. FT. SIDELINE AND 30000. FT. FORWARD, NOISE= 0.0 EPNDB
AT 0. FT. SIDELINE AND 51000. FT. FORWARD, NOISE= 0.0 EPNDB
AT 0. FT. SIDELINE AND 2500. FT. FORWARD, NOISE= 83.4 EPNDB

TIME HISTORY AT 500 FT SIDELINE

TIME=	1.5	4.5	7.5	10.5	13.5	16.5	19.5	22.5	25.5	28.5	31.5	34.5	37.5	40.5	43.5	46.5	49.5	52.5	55.5	58.5
PNL =	95.0	95.0	95.0	95.0	95.0	95.0	95.0	95.0	95.0	95.0	95.0	95.0	95.0	95.0	95.0	95.0	95.0	95.0	95.0	95.0

HOVER

NOISE FOOTPRINT IN EPNDB. FLIGHT DIRECTION DOWN THE PAGE. 250 FT. GRID

	81.0	80.9	80.6	83.3	82.7	82.2	81.5	80.9	80.2	79.5
	82.4	82.3	81.9	81.5	80.9	83.3	82.5	81.7	81.0	80.2
	84.0	83.8	83.4	82.8	82.1	81.3	80.5	82.6	81.7	80.9
	85.9	85.6	85.0	84.3	83.4	82.4	81.5	80.5	82.5	81.5
	88.1	87.6	86.9	85.9	84.7	83.6	82.4	81.3	83.3	82.2
	90.8	90.1	89.0	87.6	86.2	84.7	83.4	82.1	80.9	82.7
	94.2	93.2	91.5	89.5	87.6	85.9	84.3	82.8	81.5	83.3
	99.0	97.0	94.2	91.5	89.0	86.9	85.0	83.4	81.9	80.6
			97.0	93.2	90.1	87.6	85.6	83.8	82.3	80.9
			99.0	94.2	90.8	88.1	85.9	84.0	82.4	81.0
X										
			99.0	94.2	90.8	88.1	85.9	84.0	82.4	81.0
			97.0	93.2	90.1	87.6	85.6	83.8	82.3	80.9
	99.0	97.0	94.2	91.5	89.0	86.9	85.0	83.4	81.9	80.6
	94.2	93.2	91.5	89.5	87.6	85.9	84.3	[illegible]	81.5	83.3
	90.8	90.1	89.0	87.6	86.2	84.7	83.4	82.1	80.9	82.7
	88.1	87.6	86.9	85.9	84.7	83.6	82.4	81.3	83.3	82.2
	85.9	85.6	85.0	84.3	83.4	82.4	81.5	80.5	82.5	81.5
	84.0	83.8	83.4	82.8	82.1	81.3	80.5	82.6	81.7	80.9
	82.4	82.3	81.9	81.5	80.9	83.3	82.5	81.7	81.0	80.2
	81.0	80.9	80.6	83.3	82.7	82.2	81.5	80.9	80.2	79.5
	82.7	82.6	82.4	82.0	81.6	81.1	80.6	80.0	79.4	78.8
	81.5	81.4	81.2	81.0	80.6	80.2	79.7	79.2	78.7	78.2
	[illegible]	[illegible]	[illegible]	[illegible]	79.7	79.3	78.9	78.5	78.0	0.0
	79.4	79.4	79.2	79.0	78.9	78.5	78.1	0.0	0.0	0.0
	78.5	78.5	78.3	78.2	77.9	0.0	0.0	0.0	0.0	0.0
	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

TILT ROTOR DESIGN PROGRAM 1974

QP-80-50

DESIGN ITERATIONS: 5

OVERALL	
GROSS WEIGHT (LB)	48527.
EMPTY WEIGHT (LB)	34209.
FUEL WEIGHT (LB)	4167.
PAYLOAD (LB)	10150.
CRUISE SPEED (MPH)	429.
L/D CRUISE	9.83
*RANGE (STAT MI)	500.
*PASSENGER SEATS	50.
*CARGO (LB)	0.

ROTORS	
*DISC LOADING (PSF)	8.50
RADIUS (FT)	30.1
SOLIDITY	0.098
BLADE CHORD (FT)	3.10
TOTAL BLADES	6
*CT/SIG HOVER	0.120
*PROFILE DRAG COEFF	0.010
% DOWNLOAD	9.6
*EFFICIENCY HOVER	0.85
* CONVER	0.83
CRUISE	0.90
HEL MODE WEIGHT (LB)	5044.
AIRPLANE WEIGHT (LB)	4167.
*TIP SPEED HOVER	630.
* CRUISE	540.
*FUSELAGE CLEARNCE (FT)	1.0
*MAX HEL MODE ADV RATIO	0.40

* INDICATES INPUT VARIABLE

POWERPLANT	
INST NORMAL PWR (HP)	9642.
*NUMBER OF ENGINES	2.
*EXCESS FACTOR HEL MODE	2.00
*% RATED EMRG HVR	140.
* CONV + CLIMB	120.
* CRUISE	90.
INST PWR EMRG HVR (HP)	8904.
CONVER (HP)	9642.
CRUISE (HP)	8040.
*SFC (LB/HP HR)	0.400

DRIVE SYSTEM	
*EFFICIENCY	0.97
HEL MODE WEIGHT (LB)	6382.
AIRPLANE WEIGHT (LB)	5854.

WING	
AREA (SF)	665.
*LOADING (PSF)	73.0
ASPECT RATIO	7.86
SPAN (FT)	72.3
MEAN CHORD (FT)	9.20
*THICKNESS/CHORD RATIO	0.210
*TAPER RATIO	0.70
SWEEP (DEG)	-5.3
CRUISE LIFT COEFF	0.25
MAX LIFT COEFF CONVER	1.01
*MAX LIFT COEFF CLEAN	1.40
*FLAP AREA/WING AREA	0.25
CLIMB SPD/CONVER SPD	0.91

FUSELAGE	
*LENGTH (FT)	80.0
*DIAMETER (FT)	10.0
*DRAG FACTOR	1.00

FLAT PLATE AREAS (SF)	
WING PROFILE	4.39
FUSELAGE	5.31
EMPENNAGE	2.63
TOTAL PROFILE	14.92
WING INDUCED	1.85

COMPONENT WEIGHTS (LB)	
ROTORS	5044.
DRIVE SYSTEM	6382.
POWERPLANT	1951.
NACELLES	355.
FUEL SYSTEM	351.
WING	4091.
FUSELAGE	5648.
EMPENNAGE	946.
LANDING GEAR	1456.
FLIGHT CONTROLS	2154.
HYDRAULICS	285.
ELECTRICAL	795.
INSTR+AVIONICS	703.
AIR CONDITIONING	1150.
FURNISHINGS	2500.
FLUIDS	243.
FLIGHT CREW	400.
CABIN CREW	150.

STRUCT TECHNOLOGY FACTORS	
*ROTOR	1.
*TRANSMISSION	0.8[illegible]
*AIRFRAME	[illegible]
*ENGINE (HP/LB)	[illegible]
*ENGINE INSTALLATION	1.

DESIGN MISSION	
*FIELD ELEVATION (FT)	[illegible]
SOUND SPEED HVR (FPS)	1117.
*STD DAY TEMP (DEG F)	[illegible]
*EMERG HOVER ALT (FT)	[illegible]
*HOT DAY TEMP (DEG F)	9[illegible]
*CT/SIG MAX	0.15[illegible]
*MAX ACCELERATION (G)	[illegible]
*DESIGN CRUISE (MPH)	4[illegible]
*CRUISE ALTITUDE (FT)	[illegible]
SOUND SPEED CRSE (FPS)	[illegible]
*MAX DECELERATION (G)	[illegible]
*STRUCT LOAD FACTOR	4[illegible]
*FLIGHT CREW	2.
*CABIN CREW	1
*ATC SPEED LIMIT	YES

DESIGN MISSION	SPEED MPH	HEIGHT FT	DIST MI	TIME MIN	FUEL LB
TAKEOFF & LANDING				2.00	83.
ACCEL. & CONV.		1500.	1.3	1.03	73.
AIRPLANE CLIMB	156.,192.	13500.	11.0	3.81	200.
ACCEL. TO CRUISE			12.7	2.18	122.
CRUISE	429.		419.6	58.65	2743.
AIRPLANE DESCENT	429.,294.	13500.	31.9	5.60	37.
APPROACH		1500.	23.4	9.55	79.
TOTAL			500.0	82.82	3337.
RESERVE				20.00	831.

QP-80-50

STAGE LENGTH (MI.)	25.	50.	75.	100.	150.	200.	300.	400.	500.
CRUISE ALTITUDE (FT.)	2000.	4000.	10001.	12500.	15000.	15000.	15000.	15000.	15000.
CRUISE SPEED (MPH)	296.	305.	436.	439.	438.	438.	438.	438.	438.
CRUISE L/D	12.38	12.38	8.40	8.84	9.33	9.33	9.33	9.33	9.33
CRUISE DISTANCE (MI.)	-3.9	14.3	-2.3	22.4	66.8	116.8	216.8	316.8	416.8
BLOCK TIME (MIN.)	0.0	18.0	0.0	26.4	33.7	40.6	54.2	67.9	81.6
BLOCK FUEL (LB.)	0.	400.	0.	735.	1086.	1436.	2129.	2811.	3483.
BLOCK SPEED (MPH)	0.	166.	0.	227.	267.	295.	332.	353.	367.

DIRECT OPERATING COST - ANN UTILIZATION(HR)=2000. DEPRECIATION PERIOD(YR)=10. LABOR RATE($/HR)= 7.00
AIRFRAME COST ($/LB)= 80.0 ENGINE COST ($/HP)= 60.0 INSURANCE RATE=0.040 FUEL COST (CENTS/GAL)= 18.0
DOC=-.86+0.0344*SL $/SEAT-TRIP (SL= 25.,500.)
HOP LENGTHS 50+150+ 0+ 0+ 0=200 100+200+ 0+ 0+ 0=300 200+200+ 0+ 0+ 0=400

STAGE LENGTH	25.	50.	75.	100.	150.	200.	300.	400.	500.	200.	300.	400.
NO. CYCLES/STARTS	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	2/1	2/1	2/1
FLIGHT CREW	0.0	0.581	0.0	0.426	0.362	0.327	0.291	0.274	0.263	0.433	0.370	0.335
FUEL & OIL	0.0	0.223	0.0	0.204	0.201	0.200	0.197	0.195	0.194	0.207	0.201	0.200
HULL INSURANCE	0.0	0.380	0.0	0.278	0.237	0.214	0.190	0.179	0.172	0.272	0.235	0.214
TOTAL FLIGHT OPS	0.0	1.183	0.0	0.908	0.800	0.740	0.679	0.648	0.628	0.912	0.807	0.748
LABOR AIRFRAME	0.0	0.395	0.0	0.262	0.212	0.185	0.159	0.145	0.137	0.256	0.209	0.184
MATERIAL AIRFRAME	0.0	0.151	0.0	0.095	0.075	0.065	0.054	0.049	0.045	0.091	0.073	0.063
LABOR ENGINES	0.0	0.189	0.0	0.108	0.079	0.065	0.050	0.043	0.039	0.097	0.073	0.060
MATERIAL ENGINES	0.0	0.304	0.0	0.169	0.123	0.099	0.075	0.063	0.056	0.150	0.113	0.090
MAT. BURDEN	0.0	0.759	0.0	0.480	0.379	0.325	0.272	0.245	0.229	0.459	0.367	0.318
TOTAL MAINTENANCE	0.0	1.797	0.0	1.115	0.868	0.739	0.610	0.545	0.507	1.052	0.832	0.715
DEPRECIATION	0.0	1.096	0.0	0.803	0.683	0.616	0.550	0.516	[illegible]	0.786	0.679	0.616
TOTAL DIRECT OPERATING COST												
$/AIRCRAFT MILE	0.0	4.076	0.0	2.826	2.351	2.095	1.839	1.710	1.632	2.750	2.318	2.079
$/FLIGHT HOUR	0.0	678.5	0.0	641.8	627.8	620.0	610.0	603.9	599.6	638.1	622.9	615.3
$/SEAT MILE	0.0	0.0815	0.0	0.0565	0.0470	0.0419	0.0368	0.0342	0.0326	0.0550	0.0464	0.0416
$/SEAT-TRIP	0.0	4.08	0.0	5.65	7.05	8.38	11.03	13.68	16.32	11.00	13.91	16.63

ORIGINAL PAGE IS
OF POOR QUALITY

OF POOR QUALITY

50' 30°

13.5	16.5	19.5	22.5	25.5	28.5	31.5	34.5	37.5
90.5	90.7	88.8	84.1	78.7	72.9	68.4	64.7	59.4

NOISE FOOTPRINT IN EPNDB. FLIGHT DIRECTION DOWN THE PAGE. 250 FT. GRID

72.2	72.0	[illegible]	69.1	68.6	65.3	0.0	[illegible]	0.0	0.0
74.2	74.0	[illegible]	73.2	72.0	69.0	[illegible]	[illegible]	0.0	0.0
76.0	75.8	[illegible]	74.9	73.7	72.3	[illegible]	[illegible]	0.0	0.0
78.1	77.9	[illegible]	76.1	75.4	74.5	72.3	[illegible]	64.9	0.0
79.9	79.6	[illegible]	78.1	77.1	75.4	74.4	[illegible]	69.9	0.0
82.2	81.7	[illegible]	79.7	78.3	77.1	75.2	[illegible]	71.5	0.0
83.0	81.4	[illegible]	0.0	79.4	78.2	75.9	74.5	72.7	64.8
87.6	86.2	[illegible]	[illegible]	80.5	[illegible]	77.1	[illegible]	73.0	67.9
		[illegible]	81.4	81.5	79.4	77.6	[illegible]	72.2	65.1
X		[illegible]	83.1	82.2	79.8	77.8	[illegible]	72.9	68.1
		[illegible]	83.5	82.4	80.0	[illegible]	[illegible]	72.7	64.9
		[illegible]	83.6	82.5	80.1	[illegible]	[illegible]	72.2	65.6
97.8	93.4	[illegible]	84.1	82.6	80.3	78.2	[illegible]	73.3	69.1
95.6	91.9	[illegible]	82.7	82.2	80.2	78.1	[illegible]	72.7	70.7
94.6	90.6	[illegible]	84.0	81.8	79.8	77.6	[illegible]	72.9	71.7
91.6	[illegible]	[illegible]	83.4	81.4	79.3	77.4	[illegible]	73.5	70.5
91.6	87.9	[illegible]	82.8	80.7	79.0	77.5	[illegible]	73.2	[illegible]
88.9	86.5	[illegible]	[illegible]	80.2	78.5	[illegible]	[illegible]	73.0	71.0
89.6	86.0	[illegible]	[illegible]	90.0	78.5	76.8	[illegible]	72.7	64.9
87.3	85.5	[illegible]	81.3	79.7	78.2	76.5	[illegible]	72.3	0.0
87.3	84.5	[illegible]	80.7	79.0	77.5	75.9	[illegible]	70.0	0.0
87.1	85.1	[illegible]	80.7	78.9	77.4	75.7	[illegible]	67.9	0.0
87.4	84.9	[illegible]	80.6	78.9	77.1	75.3	[illegible]	64.9	0.0
89.3	86.1	[illegible]	80.9	78.8	77.1	75.2	[illegible]	68.4	0.0
[illegible]	[illegible]	[illegible]	[illegible]	79.1	77.1	[illegible]	[illegible]	[illegible]	0.0
85.9	[illegible]	[illegible]	[illegible]	78.9	77.0	75.3	[illegible]	[illegible]	67.9
84.2	83.2	[illegible]	[illegible]	78.3	76.8	[illegible]	[illegible]	70.1	68.4
82.3	81.6	[illegible]	[illegible]	77.5	[illegible]	74.2	[illegible]	[illegible]	[illegible]
81.1	80.3	[illegible]	[illegible]	[illegible]	75.1	73.5	[illegible]	70.0	68.8
79.7	79.0	[illegible]	[illegible]	75.5	74.4	72.9	[illegible]	69.8	[illegible]
78.2	77.6	[illegible]	[illegible]	[illegible]	73.2	71.5	[illegible]	69.5	66.3
77.6	76.7	[illegible]	[illegible]	73.1	71.7	70.9	[illegible]	[illegible]	[illegible]
76.3	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	70.2	[illegible]	[illegible]	65.7
74.6	74.1	[illegible]	[illegible]	[illegible]	70.2	[illegible]	66.9	[illegible]	65.3

QP-80-50 - 50' 60°

TIME HISTORY AT 500 FT SIDELINE

TIME=	1.5	4.5	7.5	10.5	13.5	16.5	19.5	22.5	25.5	28.5	31.5	34.5	37.5
PNL =	85.8	86.4	86.9	88.9	92.0	91.9	90.0	86.3	80.9	75.0	69.3	64.8	60.4

NOISE FOOTPRINT IN EPNDB. FLIGHT DIRECTION DOWN THE PAGE. 250 FT. GRID

72.7	71.8	71.6	71.1	70.6	68.5	65.2	0.0	0.0	0.0
74.6	74.4	74.2	73.7	72.6	71.0	70.2	65.2	0.0	0.0
76.3	75.8	75.5	74.9	74.2	72.9	72.1	70.2	64.9	0.0
78.7	78.5	78.0	77.1	75.4	74.5	73.0	72.0	69.9	0.0
80.5	80.2	79.6	78.7	77.8	75.9	74.5	72.8	71.7	64.8
82.7	82.2	81.4	80.3	79.0	77.8	75.7	74.5	72.2	69.8
84.0	83.2	81.0	75.4	80.3	78.8	77.1	75.1	72.7	71.4
88.9	87.5	84.1	81.1	81.5	79.7	78.0	75.6	73.7	71.7
		87.7	83.9	82.6	80.5	78.5	76.0	74.0	72.6
		89.6	85.0	83.3	81.0	79.0	76.8	74.1	72.6
X		90.4	85.8	83.6	81.2	79.2	76.9	74.1	70.9
		90.0	85.4	83.6	81.1	79.0	76.4	74.4	70.8
97.0	93.4	88.8	85.3	83.5	81.2	79.2	76.6	74.2	71.9
94.9	91.7	88.1	84.6	83.1	81.0	78.9	76.5	74.6	71.9
92.8	90.4	87.5	84.9	82.7	80.7	78.3	76.6	74.3	72.3
91.3	88.6	86.1	83.8	81.7	79.5	77.8	75.6	73.8	68.5
88.8	87.0	84.8	82.7	80.6	78.9	77.3	75.9	72.0	68.2
87.8	85.3	83.2	81.3	79.6	78.1	76.4	73.9	70.5	65.1
85.4	84.1	82.4	80.8	79.3	77.9	76.4	74.1	72.3	0.0
86.2	83.6	81.8	80.3	78.8	77.3	75.8	73.7	71.1	0.0
83.4	82.4	81.1	79.7	78.2	76.8	75.4	72.6	68.0	0.0
84.3	82.4	80.8	79.3	77.9	76.6	74.7	71.5	0.0	0.0
84.2	82.5	80.8	79.3	77.8	76.0	74.2	72.4	0.0	0.0
64.3	82.9	81.0	79.2	77.7	75.8	74.5	72.5	64.8	0.0
83.6	82.5	80.8	79.1	77.5	76.0	74.1	71.3	68.3	0.0
82.5	81.6	80.4	78.8	77.1	75.7	73.8	71.5	68.7	0.0
81.0	80.4	79.4	78.0	76.8	75.1	73.0	70.7	69.0	65.0
80.1	79.5	78.5	77.1	75.8	74.1	72.9	70.4	69.1	65.4
78.7	78.1	77.4	75.7	74.7	73.7	71.4	70.2	69.0	65.5
77.3	76.9	75.9	74.8	73.5	71.9	70.9	69.8	66.6	65.5
76.5	75.9	74.4	72.6	71.9	71.1	70.3	69.4	66.4	65.4
74.8	74.3	73.5	71.7	71.1	70.4	69.7	66.9	66.1	65.2
73.9	72.8	72.2	70.8	70.3	69.8	69.2	66.4	65.7	64.9
73.4	72.7	71.4	70.0	69.6	67.1	66.5	65.9	65.2	0.0

QP-80-50 90° 50'

TIME HISTORY AT 500 FT SIDELINE

TIME=	1.5	4.5	7.5	10.5	13.5	16.5	19.5	22.5	25.5	28.5	31.5	34.5	37.5	40.5	43.5
PNL =	85.8	86.5	87.2	89.4	93.0	92.6	91.0	88.0	84.0	78.7	72.8	66.7	62.6	60.1	57.8

NOISE FOOTPRINT IN EPNDB. FLIGHT DIRECTION DOWN THE PAGE. 250 FT. GRID

74.0	73.9	73.1	72.7	72.2	70.6	69.9	0.0	0.0	0.0
75.8	75.7	75.3	74.9	74.4	72.6	71.9	70.0	0.0	0.0
77.1	76.9	76.5	75.6	75.0	74.2	73.5	71.9	69.8	0.0
79.5	79.3	78.6	77.5	76.5	75.3	74.4	73.5	71.7	0.0
81.4	81.0	80.4	79.6	78.6	76.7	75.3	74.2	73.2	71.2
83.6	83.1	82.3	81.2	79.9	78.7	76.9	75.0	73.8	72.6
85.3	84.1	82.1	80.4	81.3	79.8	78.2	76.4	74.3	73.1
		85.5	82.9	82.5	80.7	79.1	77.0	75.3	73.4
		88.8	84.9	83.7	81.6	79.7	77.7	75.6	74.2
X		90.7	86.4	84.5	82.2	80.1	78.0	76.2	74.4
		91.2	86.8	84.8	82.5	80.5	78.5	76.2	74.4
98.3	94.7	90.7	86.9	84.8	82.5	80.5	78.3	76.5	73.3
94.8	92.5	89.3	85.5	84.4	82.2	80.2	77.9	75.7	73.2
92.8	90.9	88.1	85.5	84.2	82.1	80.0	77.8	75.9	73.9
91.7	90.0	87.9	85.8	83.7	81.8	79.7	77.8	76.0	74.2
90.0	88.6	86.8	84.9	83.0	80.9	79.1	77.3	75.2	73.7
88.8	87.3	85.6	83.8	81.9	80.1	78.2	76.4	74.5	71.7
87.2	85.9	84.4	82.6	81.0	79.3	77.8	76.0	73.7	69.8
85.8	84.5	83.0	81.4	79.8	78.2	76.8	75.1	71.2	64.8
83.8	82.7	81.4	79.9	78.5	76.9	75.3	72.9	65.0	0.0
82.8	81.1	79.7	78.4	77.2	75.9	72.3	67.9	0.0	0.0
80.0	79.4	78.5	77.5	75.6	73.8	71.5	65.0	0.0	0.0
80.6	79.8	78.9	77.7	76.1	74.2	72.4	0.0	0.0	0.0
81.8	80.6	79.1	77.8	76.2	74.5	72.7	65.1	0.0	0.0
81.8	80.8	79.3	77.7	76.3	74.5	72.4	68.7	0.0	0.0
82.4	81.0	79.7	78.3	76.6	75.2	72.9	69.4	64.9	0.0
82.4	81.2	79.8	78.4	77.0	75.3	73.3	70.0	68.3	0.0
82.0	81.1	79.9	78.4	76.8	75.1	73.1	71.4	68.[illegible]	64.8
81.3	80.4	79.4	78.2	76.6	75.3	73.1	71.1	70.4	65.1
80.3	79.5	78.7	77.6	76.2	74.5	73.[illegible]	71.8	70.6	65.2
79.1	78.5	77.7	76.8	75.4	74.3	72.3	71.7	69.3	68.2
77.8	77.3	76.5	75.8	74.9	73.5	72.5	71.5	69.3	68.3
76.3	76.1	75.6	74.4	[illegible]	[illegible]2.9	72.0	7[illegible].1	69.2	68.[illegible]
74.[illegible]	[illegible].4	74.0	73.[illegible]	[illegible]	[illegible].3	[illegible]	[illegible]	[illegible]	[illegible]

QP-80-50 100' 30°

TIME HISTORY AT 500 FT SIDELINE

TIME=	1.5	4.5	7.5	10.5	13.5	16.5	19.5	22.5	25.5	28.5	31.5	34.5	37.5
PNL =	85.7	86.0	86.2	87.5	90.5	91.7	89.1	85.0	79.4	73.2	68.2	63.3	59.8

NOISE FOOTPRINT IN EPNDB. FLIGHT DIRECTION DOWN THE PAGE. 250 FT. GRID

OF POOR QUALITY

72.3	72.2	71.1	70.6	68.8	68.1	0.0	0.0	0.0	0.0
74.8	74.6	74.3	73.3	72.1	70.5	68.3	0.0	0.0	0.0
76.2	76.0	75.6	75.1	74.5	72.5	70.7	68.3	0.0	0.0
78.3	78.0	77.6	76.3	75.6	74.7	73.2	70.6	68.0	0.0
80.3	79.9	79.3	78.5	77.3	75.7	74.6	73.1	70.2	0.0
82.4	81.9	81.1	80.0	78.8	77.5	75.4	73.7	72.6	64.9
83.2	81.6	79.1	0.0	79.7	78.5	76.5	74.8	73.0	69.8
87.8	86.4	83.3	79.0	80.9	79.1	77.4	75.0	73.4	71.2
		86.9	81.8	81.9	79.8	78.0	75.4	73.5	70.3
		88.8	83.6	82.6	80.4	78.3	75.6	73.6	70.4
		89.7	84.2	83.0	80.6	78.6	75.6	73.5	71.4
		89.7	85.0	83.2	80.8	78.8	76.2	73.7	71.4
97.7	94.0	88.9	85.3	83.3	81.0	78.9	76.5	74.4	71.7
95.6	92.2	88.3	84.4	83.0	80.9	78.8	76.5	75.0	72.7
94.1	90.6	87.3	84.6	82.3	80.2	78.0	76.4	74.2	70.7
91.5	88.8	86.1	83.7	81.7	79.6	77.7	76.2	72.8	70.7
89.8	87.1	84.6	82.5	80.4	78.7	77.2	75.2	72.4	70.4
88.0	85.8	83.8	81.9	80.3	78.6	77.2	75.7	73.1	71.2
87.3	85.1	83.1	81.4	79.8	78.4	76.8	74.5	72.8	69.7
85.0	83.7	82.1	80.6	79.2	77.7	76.1	74.1	72.4	0.0
85.2	83.4	81.8	80.2	78.7	77.3	75.8	74.2	71.1	0.0
85.2	83.4	81.8	80.2	78.7	77.3	75.8	74.2	71.1	0.0
84.7	83.4	81.7	80.0	78.5	77.1	75.5	73.4	68.0	0.0
85.4	83.4	81.7	80.0	78.5	76.8	75.1	72.8	0.0	0.0
86.3	84.2	82.1	80.2	78.5	76.8	74.9	73.6	65.5	0.0
85.6	84.1	82.2	80.3	78.3	76.7	75.2	72.6	68.6	0.0
84.3	83.2	81.7	79.9	78.3	76.4	74.9	72.3	69.3	0.0
82.8	82.0	80.9	79.3	77.7	76.3	74.5	72.3	69.6	68.1
81.2	80.6	79.7	78.6	77.0	75.5	73.7	72.3	69.7	68.4
80.2	79.4	78.5	77.3	75.7	74.6	73.4	70.9	69.7	68.5
78.7	78.2	77.3	75.8	75.0	74.0	72.5	70.6	69.5	66.0
77.3	76.9	76.0	74.9	73.6	72.8	71.1	70.2	69.2	65.9
76.1	75.5	74.4	73.3	72.0	71.3	70.5	69.7	68.8	65.7
75.2	74.2	73.5	71.6	71.1	70.6	69.9	69.2	66.2	65.4
73.7	72.7	72.1	70.7	70.3	69.9	69.3	66.5	65.8	65.1

QP-80-50 60° 100'

TIME HISTORY AT 500 FT SIDELINE

TIME=	1.5	4.5	7.5	10.5	13.5	16.5	19.5	22.5	25.5	28.5	31.5	34.5	37.5	40.5	43.5
PNL =	85.0	86.4	86.9	88.9	92.7	92.7	90.2	86.8	82.5	77.3	71.4	65.9	62.3	50.5	57.1

NOISE FOOTPRINT IN EPNDB. FLIGHT DIRECTION DOWN THE PAGE. 250 FT. GRID

72.9	72.7	72.5	72.1	70.8	70.0	65.[illegible]	0.0	0.0	0.0
75.1	75.0	74.2	73.8	72.7	72.1	70.3	65.2	0.0	0.0
76.8	76.3	76.0	75.5	74.9	73.1	72.3	71.4	65.0	0.0
78.9	78.7	78.2	77.4	76.1	75.3	73.9	72.3	71.3	0.0
80.9	80.6	80.0	79.0	78.0	76.3	75.3	73.8	72.0	69.8
83.0	82.6	81.7	80.7	79.5	78.3	76.2	75.0	73.4	71.4
84.1	83.3	81.3	78.2	80.8	79.4	77.8	75.7	74.0	72.8
89.1	87.7	84.8	81.4	82.1	80.4	78.8	76.7	74.5	73.2
		88.1	84.4	83.2	81.2	79.4	77.2	75.4	73.5
X		90.2	86.0	84.1	81.8	79.9	77.8	75.7	74.3
		91.0	86.6	84.6	82.2	80.1	78.0	75.8	74.4
		90.6	86.3	84.6	82.3	80.3	78.0	75.9	74.4
96.0	92.9	89.3	86.3	84.4	82.2	80.2	77.9	76.1	73.3
93.4	91.3	88.5	85.2	84.1	82.0	80.0	77.9	76.1	73.8
92.0	90.4	88.3	86.1	84.0	82.0	79.8	78.2	76.6	74.9
90.8	89.2	87.3	85.2	83.3	81.2	79.5	77.7	75.9	74.0
89.4	87.9	86.2	84.3	82.4	80.5	78.9	77.1	75.4	72.9
87.9	86.6	85.0	83.3	81.6	80.0	78.5	76.9	74.3	72.2
86.6	85.2	83.7	82.2	80.6	79.1	77.7	75.7	74.0	0.0
85.2	83.9	82.5	81.1	79.6	78.1	76.2	74.9	69.6	0.0
83.9	82.7	81.3	80.0	78.5	77.2	75.6	73.5	0.0	0.0
82.9	81.3	79.8	78.5	77.2	75.7	73.7	0.0	0.0	0.0
81.0	80.2	79.1	78.0	76.7	74.5	71.6	67.9	0.0	0.0
7[illegible].9	78.6	77.8	76.6	74.9	73.0	71.2	0.0	0.0	0.0
80.2	79.4	78.2	77.1	75.2	74.0	71.3	0.0	0.0	0.0
80.5	79.5	78.1	76.8	75.6	73.8	70.8	67.8	0.0	0.0
81.5	80.2	78.9	77.4	76.0	74.7	70.2	68.7	0.0	0.0
81.5	80.5	79.2	77.8	76.2	74.2	72.0	69.1	65.1	0.0
81.3	80.5	79.2	77.8	76.0	74.6	72.4	71.0	65.6	0.0
80.4	79.9	78.8	77.5	76.2	74.1	72.7	71.3	68.6	0.0
79.6	79.0	78.2	77.2	73.4	74.1	72.9	71.4	68.9	64.9
78.4	77.8	77.2	76.1	75.0	73.9	72.5	71.4	69.1	68.0
76.9	76.6	76.1	75.4	74.0	73.1	72.2	70.1	69.1	68.1
75.9	75.0	74.6	74.0	73.3	72.6	70.8	69.9	69.0	65.4

ϕP-80-50 100' 90°

TIME HISTORY AT 500 FT SIDELINE

TIME=	1.5	4.5	7.5	10.5	13.5	16.5	19.5	22.5	25.5	28.5	31.5	34.5	37.5	40.5	43.5
PNL =	85.8	86.5	87.2	89.4	93.6	94.1	91.0	88.2	84.8	81.3	78.0	74.1	70.3	67.0	63.2

NOISE FOOTPRINT IN EPNDB. FLIGHT DIRECTION DOWN THE PAGE. 250 FT. GRID

74.1	74.0	73.2	72.9	72.4	70.9	70.3	68.0	0.0	0.0
76.3	76.1	75.8	75.5	74.0	72.9	72.2	70.5	68.0	0.0
77.5	77.3	77.0	76.2	75.6	75.0	73.2	72.3	70.4	64.9
79.9	79.7	79.3	78.3	77.1	76.1	75.2	73.8	72.2	70.1
81.8	81.5	80.9	80.1	79.2	77.7	76.5	75.2	73.7	71.9
83.9	83.5	82.7	81.7	80.6	79.4	77.7	76.4	74.0	73.2
85.4	84.3	83.0	79.5	82.0	80.5	79.0	77.4	75.9	73.8
90.1	88.8	86.2	83.3	83.3	81.7	80.2	78.1	76.5	75.3
		89.2	85.8	84.5	82.6	80.9	79.1	77.0	75.7
		91.3	87.0	85.4	83.2	81.4	79.5	77.9	76.3
		91.9	87.8	85.8	83.7	81.7	80.0	78.2	76.6
		91.2	87.6	85.9	83.8	82.0	80.1	78.3	76.7
94.1	92.3	89.7	87.1	85.6	83.7	81.9	80.0	78.4	76.7
91.4	90.2	88.3	86.1	85.2	83.4	81.7	79.9	78.4	76.7
90.3	89.3	87.9	86.4	84.7	83.1	81.3	79.8	78.1	76.3
89.1	88.3	87.1	85.7	84.2	82.6	81.1	79.5	77.8	75.9
88.4	87.6	86.5	85.2	83.7	82.3	80.8	79.4	78.1	75.8
87.6	86.9	85.8	84.6	83.3	82.0	80.7	79.3	77.3	75.6
86.9	86.1	85.2	84.0	82.8	81.5	80.3	78.6	77.0	75.4
86.1	85.4	84.5	83.5	82.3	81.0	79.6	78.0	76.6	75.1
85.3	84.6	83.8	82.8	81.6	80.4	79.0	77.7	75.9	74.3
84.6	83.9	83.1	82.1	81.1	79.6	78.4	76.6	75.4	73.9
83.8	83.2	82.4	81.5	80.3	78.8	77.3	76.1	75.0	72.8
82.9	82.3	81.4	80.4	79.3	78.1	77.0	75.5	74.0	72.2
82.1	81.4	80.5	79.6	78.5	77.5	76.3	74.9	73.4	71.6
81.3	80.7	79.9	79.0	78.0	76.8	75.3	74.3	72.7	68.2
80.8	80.0	79.0	78.1	77.2	76.1	75.1	73.0	70.1	0.0
79.9	79.4	78.6	77.6	76.4	75.4	74.0	71.5	0.0	0.0
79.7	78.7	77.7	76.8	75.7	74.3	72.0	69.8	0.0	0.0
78.8	77.9	76.8	75.8	74.2	73.1	71.4	64.8	0.0	0.0
77.9	77.1	76.2	74.6	72.9	71.0	68.3	0.0	0.0	0.0
77.4	76.2	74.7	73.3	72.2	68.9	64.8	0.0	0.0	0.0
75.6	74.7	72.9	71.7	70.5	65.3	0.0	0.0	0.0	0.0
72.8	72.3	71.3	69.0	65.0	0.0	0.0	0.0	0.0	0.0